The Electrical World.

VOL. XXXI. NEW YORK, MAY 28, 1898. No. 22.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

In the United States, Canada or Mexico; other foreign countries, $6.00.

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXI. NEW YORK, MAY 28, 1898. No. 22.

CONTENTS.

Editorials 637
Electrical Engineering at Purdue University 639
Lewiston, Idaho, Long-Distance Transmission 644
Sectional Conductor Electric Railways, by George T. Hanchett 645
At the Exposition 648
Digest of Current Electrical Literature, compiled by Carl Hering 656
A Sixty-cycle Rotary Converter 661
A New Type of Automatic Motor Starter 662
An Automatic Lightning Arrester 662
Automatic Cut-off Engine 662
Departments:
Financial Intelligence 663
Special Correspondence 663
General News 665
Legal Note 666
Personal Notes 667
Trade and Industrial Notes 667
Business Notes 668
Illustrated Record of Electrical Patents 668

THE ENGINEER FACTOR.

In a very valuable paper on the cost of generation and distribution of electrical energy, recently read before the English Institution of Electrical Engineers, Mr. Robert Hammond discussed a mass of data from the various central station installations in Great Britain in an endeavor to ascertain the relative importance of the various factors that enter into the total of costs for the manufacture of electricity by such stations. Considering total output, load factor and reliability of plant as the largest factors to be taken into account, he incidentally mentions what he happily terms "the engineer factor" as one important to be reckoned in any accounting of the duty of an electricity generating station. As he gives no precise definition of this term perhaps it may be well to consider the bearing of this factor in American practice, and endeavor to fix its relative importance among those that go to make up the whole.

In Mr. Hammond's paper the term was used with the significance of what would be called superintendent factor here. The importance of engineer factor is perhaps as apparent in the planning and erection of stations as in their management. All conditions of demand and costs of supplies being identical, of two stations working under the same superintendence that which is best designed and best constructed will certainly show the higher economy. In the original planning of a station there is too often a disposition to a penny wise and pound foolish policy that can well be called low engineer factor. The choice of apparatus and system, which should be governed by considerations of the class and amount of service and of many elements too numerous for mention here; the arrangement of buildings and machines, the attention to the minutiæ of economy, coal delivery, mechanical stoking, etc., are the indices by which good engineer factor in the installation of a plant is to be judged. There can be no question that it is in the installation that low engineer factor will prove itself most detrimental, because the effects of it are cumulative during the life of the plant.

In the operation of the plant the question of superintendent factor is quite as important as that of load factor. Indeed, when its reference to the other elements of the successful operation of an electricity supply station are considered, the efficiency of the man in charge is the most important factor in the total. Without good management and careful supervision it is not possible to reduce the costs of generation or increase the volume of output except under peculiarly favorable circumstances. It is possible for a station to have prosperity thrust upon it, but it is more usual for this to be attained only at the cost of everlasting and properly directed effort. Here it is that the element of superintendence enters and here is most often the weak place in an otherwise excellent installation. While it is not possible to rate the efficiency of a man in the accurate terms that are employed when machinery is in question, it is true that there should be some sort of attempt made to average the performance of all the parts of the generating mechanism at the highest figure. In this should invariably be included the efficiency of the superintendent—a quantity vastly more important to the success of the plant than the efficiency of engines or dynamos.

No general rule can be laid down for the determination of superintendent factor. It is rather an elusive quantity, unfortunately. Perhaps it would be well for the owners of plants to remember, however, that like everything else worth having it costs money.

It is poor economy to hire cheap men to oversee the operation of expensive machinery, and still worse to employ cheap men to install a plant, wherein a mistake in the selection of proper apparatus may mean a continual and increasing lack of efficiency in operation. Since it is the business of an electric station to generate electric energy at the lowest cost and sell the greatest amount of it at the highest profit it well behooves those who own such installations to consider the two important elements of engineer factor and superintendent efficiency.

MULTIPLE AND DIVIDED TYPE SWITCHBOARDS.

The London "Electrician," after reprinting the article on the new John Street exchange of the New York Telephone Company published in the April 16th issue of THE ELECTRICAL WORLD, proceeds to criticise adversely the use of what is known as the divided type of switchboard. This style of board, in which each line is not multipled in jacks within reach of all the operators, but simply runs to jacks at the incoming trunk sections and at the section of its own answering operator, requires, of course, that each connection shall be made through the agency of two operators instead of one. The following is quoted from the "Electrician": "A clumsy system of transfer working is employed instead of multiple switching, although the exchange is equipped for no fewer than 1200 subscribers. * * * That nearly every local connection in a 1200 subscriber exchange shall have to be dealt with by two operators is distinctly a retrograde step."

The first error of the "Electrician" is its sweeping criticism of a board that was distinctly stated to be merely a temporary installation, the company waiting for the perfection of the details of the so-called common battery relay system, by which all signalling shall be done automatically by visual devices without the ringing of any bells by subscribers, and all subscribers' microphones shall be supplied with current from the exchange battery. Even were the equipment a permanent one, however, its use is defendable under the conditions existing at this exchange. The possible 1200 lines for which the board is provided will constitute but a small portion of the system of the New York Telephone Company, and therefore but a small percentage of the calls coming in to this board are for stations connected to the same exchange. Where the trunk calls, that is calls to other exchanges, exceed 60 or 70 per cent. of the total number of calls on a board, it is not worth while, particularly in large exchanges, to adopt the multiple system. There are other advantages of the divided type board beside low first cost. The great complexity due to the enormous number of multiple connections gives rise to no little trouble in the multiple type. A 5000 line board, for example, requires some forty-four spring jacks to every line, while a divided type board of the same capacity can work with six or eight. The installation of this mass of somewhat troublesome devices is not warranted by the small percentage of local calls on the boards of a large telephone system. With any system all trunk line calls or, as the English term them, junction line calls must be answered by the manipulation of two operators, and the divided type board simplifies greatly the operation, as all local connections are completed just as are the trunk line connections. The necessity for completing the connection by the agency of two operators is not as serious as the "Electrician" would make out. Repeated tests on the lines of the New York Telephone Company show that the average difference between the time of completing trunk connections and local connections on multiple boards is less than ten seconds. Local connections on divided boards of course correspond exactly in the matter of operation with trunk connections. Simplicity, entirely aside from the reduction in first cost, is a great desideratum in telephone as in all other works, and the divided type is certainly an advance in this direction over the multiple board.

The "Electrician" goes on to compare the number of subscribers handled by each operator in England and America, the figure in England varying from fifty to sixty-six subscribers, and in America from eighty to one hundred. Such comparisons are always unfair unless the relative average traffic per subscriber is known, and also the load factor of the daily traffic curve. In different countries also there is a great difference between what really constitutes a connection. In Liverpool, for example, this being one of the cities cited by our contemporary, the operator does not supervise the connection at all, but merely rings up the subscriber wanted and leaves the calling subscriber to do the rest, disconnecting the lines when the ringing off drop comes down. In this country, on the contrary, the operator looks after the wants of the calling subscriber and helps him to get the party wanted and always makes sure by cutting in that the conversation is completed before disconnecting. This makes the difference between English and American practice even more remarkable. Our contemporary asks: "Are the American operators smarter than the English ones, or is it that the subscribers are more patient?" Americans are not noted for their lack of smartness or for their patient endurance of incompetency.

SUBMARINE CABLES IN TIME OF WAR

Under the above caption the London "Electrician" reviews the status of cables with reference to the possibility of their destruction by one or the other belligerent powers in the present war and, while touching lightly upon the delicate question of the rights of neutrals owning such arteries of communication, brings out the practical impossibility of a total interruption of the cable service between this country and Europe. Even if the twelve direct lines ending in United States and Canadian territory were cut it would be necessary to also interrupt the three lines landing in Brazil to entirely sever our communications with the other side of the Atlantic.

While the possibility of our isolation by the cutting of cables is too remote for serious consideration, it is interesting to note the location of cables in the West Indies, with reference to the events that are likely to transpire in that region very shortly. Cuba is connected to the rest of the world by three cables, one from Havana to Key West and thence to the American mainland, one to Jamaica and one to Hayti. Porto Rico has four cables, one to St. Thomas, one to St. Croix and two to Jamaica. The cable to St. Thomas is owned by a French company, and its landing on that island is not a message station, but only a point of call where there is a testing station. At this time the attitude of the Danish Government, which owns the island, is stated to be adverse to the establishment of a message station there. The cables to Jamaica, both from Porto Rico and Cuba, there connect with the system which goes on all English territory via Bermuda and Halifax. Consequently the only way to isolate either Cuba or Porto Rico from communications would be by the cutting of these cables or the capturing of their landings. It is useless to discuss here either the propriety or advisability of these methods, but it seems, as the "Electrician" says, a bad precedent to begin the indiscriminate cutting of cables owned by neutrals.

The cutting of the Hong-Kong-Manilla cable is still fresh in the memory, and can doubtless be defended as an act of military necessity and one not so injurious to the rights of the neutral owner as it would have been if the cable did not terminate at the Philippines. It is interesting to note in connection with this cable that it is only very recently that the land line from Manilla to Cape Bolinao, a point on the island of Luzon, some 125 miles distant, has been superseded by a cable, thus making the line to Hong-Kong all submarine. The land line across the island had suffered frequent interruptions in the insurrection that has been in progress in those islands for some time.

upon the electrical equipment. Steam is conveyed to the engine at 135 pounds pressure through a 6-inch main from the boiler plant of the mechanical laboratory located 800 feet distant. The pipe condensation is collected by a steam trap in the basement and a separator at the engine and is discharged into a dry well behind the building.

The engine drives a 3-inch line shaft that is placed in the basement and extends north and south through the middle of the laboratory. The line shaft is divided into three sections, connected by friction clutches. The engine is belted to the short middle section. The general laboratory apparatus, located on the east and west piers, is belted to the south section, and the special machines of

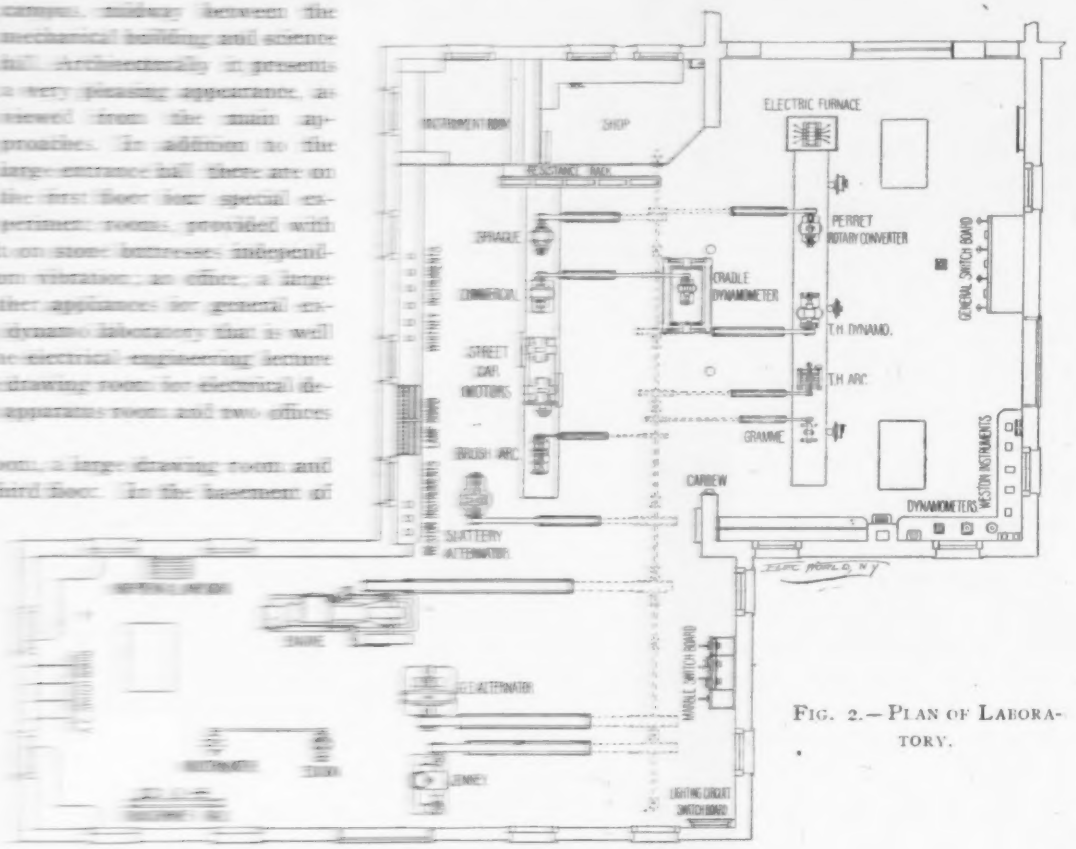


FIG. 2.—PLAN OF LABORATORY.

larger capacity to the north end. There is a friction clutch pulley provided for each electrical unit belted to the shafting; the system is therefore perfectly flexible and each machine can be operated at will and independently of all the others.

Fig. 3 is a general view of the laboratory taken from its northeast corner. In the centre of the picture and at the back can be seen the general switchboard and the overhead wire racks, a better view

FIG. 1.—THE ELECTRICAL BUILDING.

of which is given in Fig. 5. At the general switchboard, which affords facilities for making 472 connections, terminate the majority of the leads from the dynamo and motor, brush and field terminals, the lines from the laboratory voltmeters, ammeters and wattmeters, the lines from the rheostats and lamp boards, and the trunk

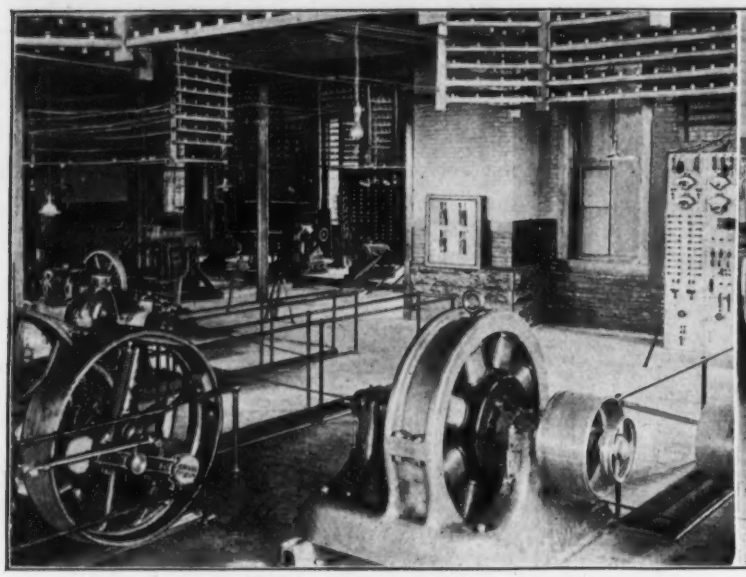


Fig. 3.—General View of the Senior Laboratory.

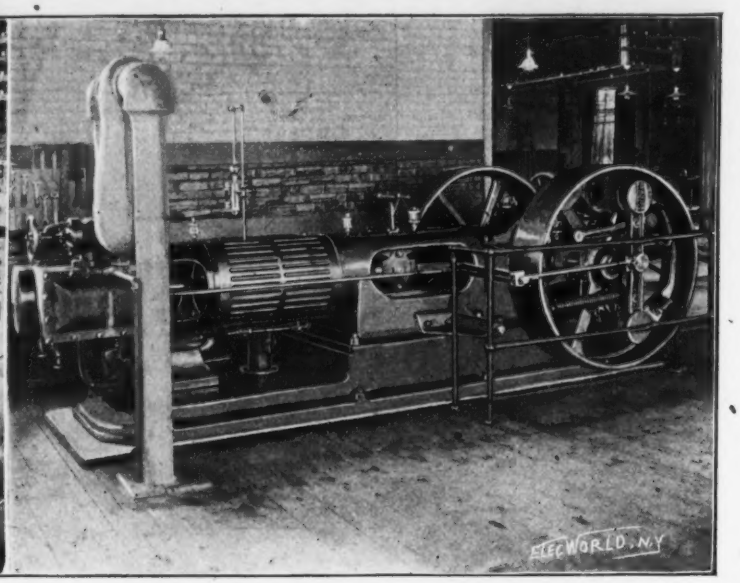


Fig. 4.—The 100-hp High-Speed Engine.

lines from the six other switchboards, located in the various parts of the building. A special signal board, together with sets of signal circuits and lamps, makes it possible for experimenters located anywhere in the building to signal to one another by means of flashes of light. As the lamps are of different colors an experimenter does not have to be near the signaling apparatus in order to receive the signal, and the system is found to work very satisfactorily. The seven switchboards have a total terminal capacity of 942 connections, and practically all of the terminals are wired up either to the instruments or to the electrical machinery. The majority of the instruments are placed in permanent adjustment, either in the pier rooms, in the photometer room, or on a heavy shelf that extends entirely around the dynamo laboratory. The positions occupied by many of the latter are indicated in Fig. 2.

The laboratory instruments are of late design and from the best makers. For potential measurements the department is supplied with a set of Kelvin electrostatic instruments, including a quadrant electrometer, multicellular and vertical high-potential voltmeters, Ayrton quadrant electrometer, Edelmann quadrant electrometer, two Deprez-Carpentier voltmeters, a Cardew voltmeter, three Western Electric Company voltmeters, four Weston voltmeters, two Whitney and three Thomson voltmeters. Several of the above are provided with multiplying coils, increasing their range of reading. For measurements of current there are two Kelvin balances, the deci-ampere and composite, three Weston, two Western Electric Company, an Ayrton and Perry, two Carpentier, four Whitney and three Thomson ammeters; four Siemens electro-dynamometers, and several tangent and sine galvanometers, including one of the Helmholtz-Gaugain type with coils 80 centimeters in diameter.

For measurements of power there are two Weston and two Thomson indicating wattmeters and one Thomson and one Fort Wayne recording wattmeter.

Of other special and delicate apparatus may be mentioned the following: A Kew unifilar magnetometer, with corrections from the Kew Observatory; three Wiedemann mirror galvanometers, a Rosenthal microgalvanometer, four D'Arsonval galvanometers, a Nalder ballistic galvanometer, a Kelvin astatic galvanometer of 13,000 ohms resistance, a Weber electro-dynamometer, a Rowland D'Arsonval galvanometer, with damper and ballistic coil, a Kelvin rheostat, ten standard resistance boxes by Edelmann and Hartmann & Braun, an Anthony 100,000 ohm box, a standard B. A. ohm, a one-third and a standard sub-divided microfarad condenser, an Ayrton secohmmeter and standard of self-induction, a dip circle by Elliott, an earth-inductor by Willyoung, cadmium cells, the usual reading telescopes, simple galvanometers and other instruments of less value.

All the laboratory wiring is installed strictly in accordance with the underwriters' rules, and the greater portion of it is carried on overhead racks and porcelain insulators. This plan enables the student to trace out connections without difficulty. All lines are numbered at both ends and labeled at the switchboard.

The main lamp board is pictured in Fig. 6; the terminals of all the lamps are brought down to mercury cups located in the boxes at the bottom of the cup. By means of these the lamps can be connected all in series or all in parallel, giving a range in resistance of from 1 to 40,000 ohms. The board has a capacity of 100 amperes and is divided into six sections, each of which is wired to the general switchboard.

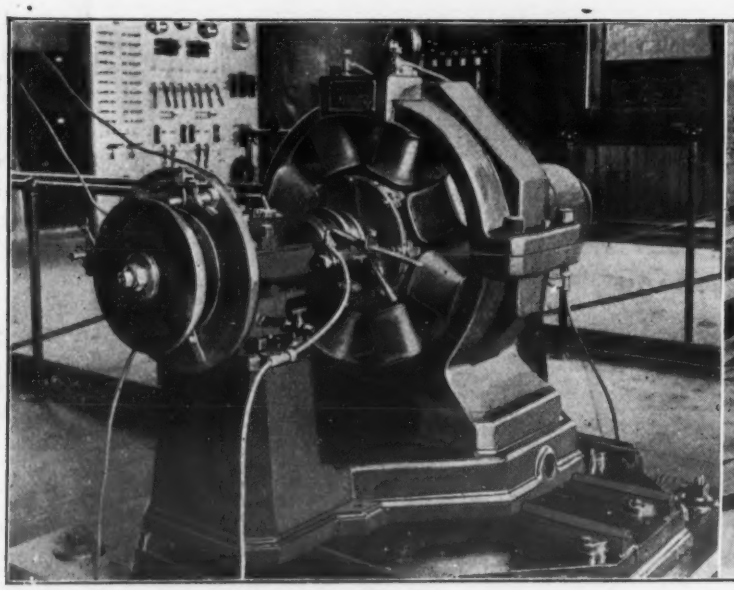


Fig. 14.—The Slattery Alternator.

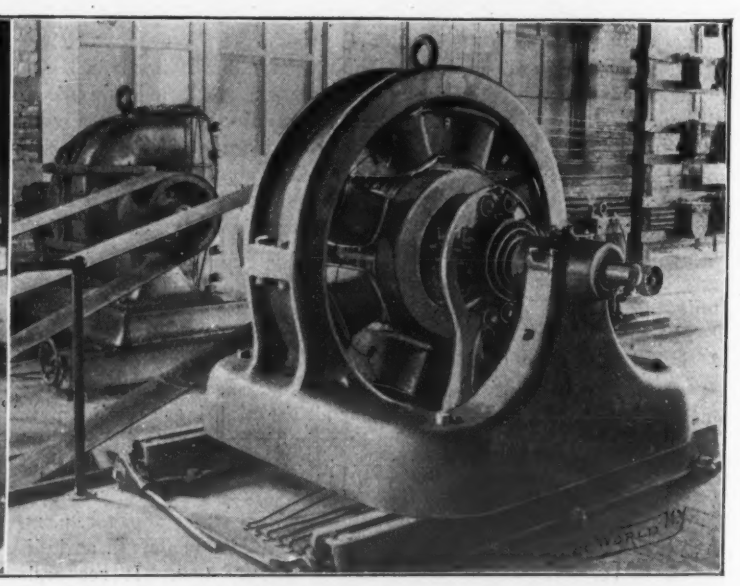


Fig. 15.—A General Electric Alternator and the Jenney Power Generator.

To supplement the lamp board and in addition to the twelve dynamo rheostats a series of 250 german silver coils, extending from floor to ceilng, have been mounted in a rack shown on the right hand side of Fig. 7. These coils are so arranged that any desired resistance from .08 to 1250 ohms can be readily obtained, and they have sufficient capacity so that dynamo currents may be carried as high as 1000 amperes for the lower resistances. This rack is divided into five main sections, and each section has twenty-five sub-divisions.

The senior laboratory contains over twenty dynamos and motors of eleven different makes, and includes among the number machines of fifteen different types. For direct-current working, there are both incandescent and arc dynamos and motors of different voltages and outputs. Series and shunt dynamos and motors, street railway motors, compound-wound generators, and motors differentially wound for constant speed are included among these machines. Some of these dynamos are shown in Figs. 7, 8 and 9. The street-railway motor-testing equipment is especially worthy of notice. This set consists of two No. 10 General Electric street-car motors with controller, and all connections and rheostats complete. The reduction gears have been removed and cast-iron brake wheels are mounted directly on motor shafts. The rim of each of these wheels is pierced with twelve holes, and brake bands of cotton belting surround them. As the motors are speeded up oil and water are run into the inside of the brake wheel rims, and, being forced through the holes in the rims by centrifugal action, both lubricate and by evaporation carry off the heat from the wheel rim. The brakes do not throw the least bit of water, and, as any tendency to bind is relieved both by the springs at the ends of the belting and by the lubricant, their action is very smooth and regular.

Of the machines shown in Fig. 9 those at the right and left hand sides of the picture are the most interesting. The machine at the right is one of two Gramme machines, imported from France for the Centennial Exposition, at Philadelphia, in 1876. It is a series dynamo that still does good service as a piece of experimental apparatus. The machine at the left is a rotary-converter, built some years ago. It is of the Perret type, with connections so arranged that it operates with equal success as a direct-current motor or generator, a single or three-phase alternating-current generator or synchronous motor, an alternating series motor, or a converter of alternating into direct or direct into alternating currents.

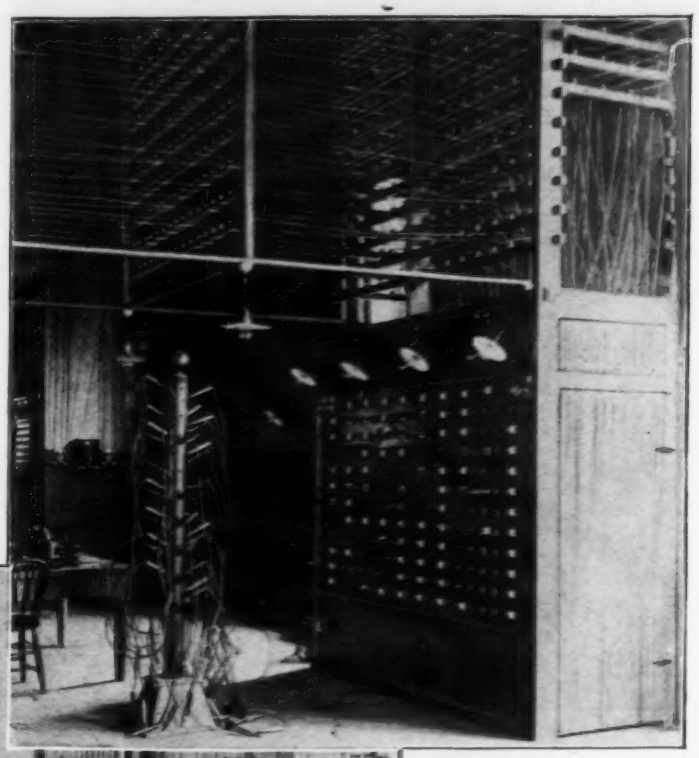


FIG. 5.—GENERAL DISTRIBUTION SWITCHBOARD AND OVERHEAD WIRING.

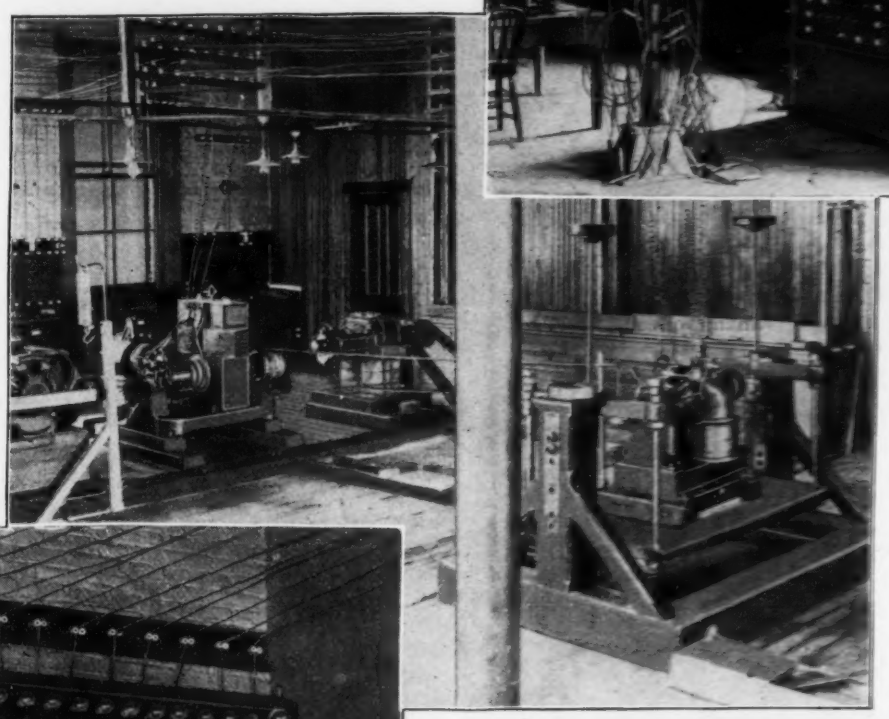


FIG. 7.—THE CRADLE DYNAMOMETER AND RESISTANCE RACKS.

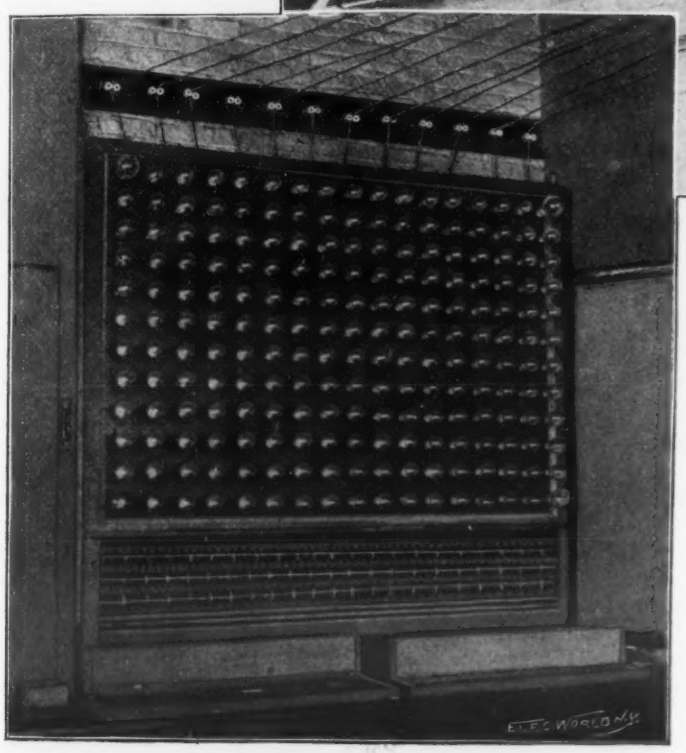


FIG. 6.—LOW VOLTAGE LAMP BOARD.

The two most prominent adjuncts to the senior laboratory are the meter room and the photometer room. The meter room is shown in Fig. 10. The room is fitted with all the appliances for ready and accurate testing on a scientific, as well as a commercial scale. The cut shows the Kelvin balances and other instruments and four meters adjusted for testing; an elaborate series of tests that are now in progress on a number of recording wattmeters includes the determinations of the wattmeter constant for variable loads, variable pressures, variable wave forms of alternating E. M. F. and current, and variable temperatures.

The photometer room is fitted for the testing and standardization of incandescent lamps, and the testing of arc lamps, which work is

also done on a commercial scale. Within the past year the various types of inclosed direct and alternating current arc lamps have been tested in this laboratory, and numerous incandescent lamps have been standardized. In addition to the standard photometric apparatus, special electrical measuring instruments, rheostats and recording devices are provided for the control of the dynamo and storage battery used in this work. In this connection attention is called to the arc lamp rack shown in Fig. 11, on which the arc lamps are arranged for the study of the controlling mechanism and of the arc itself. On the screen at the right is shown the projection, by means of a lens, of the arc of a lamp burning at the left end of the rack.

In line with the design room work of the school the students construct each year pieces of special laboratory apparatus. Some examples of this work are illustrated in Fig. 12. The piece at the back is a rotary field transformer of polyphase-alternating currents, arranged to give any desired ratio of transformation, between primary and secondary, and currents of any desired number of phases. The piece in the centre is a new form of apparatus for testing the magnetic qualities of iron.* The test pieces used with this apparatus are shown in the foreground. The piece on the left is a rectifier of polyphase-alternating currents. All the primary and secondary windings and the collector rings and commutator are stationary, and the brushes revolve in synchronism with the rotary magnetic field. To the right is shown a unipolar dynamo designed to operate at 10,000 revolutions per minute. It has thrust bearings and a single field magnetizing coil. This is all student work, and it is well done.

*Fully described in the issue of The Electrical World of December 11, 1897.

A proper amount of attention is given to electro-chemical investigations and students are encouraged to work up these in electro-metallurgy, and to familiarize themselves with the various electrolytic and electro-thermic processes. The laboratory is supplied with the necessary apparatus for carrying on this class of experimental research.

For alternating current working there are single and multiphase alternating-current generators and induction motors, of both high and low voltage and frequency. There is also a large equipment of transformers of nearly every American make. Some of this apparatus is illustrated herewith. Fig. 14 shows the Slattery alternator. This is a smooth core machine, developing 1100 volts at a frequency of 133 cycles. The machine is unique in that it develops a perfect sine wave E. M. F. It is fitted with contact discs for determining the wave forms of alternating E. M. F. and current, as are all of the other alternating-current machines.

The latest addition to the alternating-current apparatus is an alternator of 50-kw capacity, built especially for the Purdue electrical laboratory by the General Electric Company. The test of this generator shows that its full load efficiency is 92 per cent., and its quarter load efficiency 87 per cent.; the machine is of the two-phase type with special armature connections, so that either single, two or three-phase currents or the monocyclic adjustment can be obtained at will. This machine is shown in Fig. 15. It is found to regulate well, and that motors belonging to the several systems mentioned can be operated from its circuits without difficulty. For the control of this machine the instruments and switchboard apparatus shown on the central panel of the switchboard of Fig. 16 have been

Fig. 8.—The Street-Car Motor Testing Set.

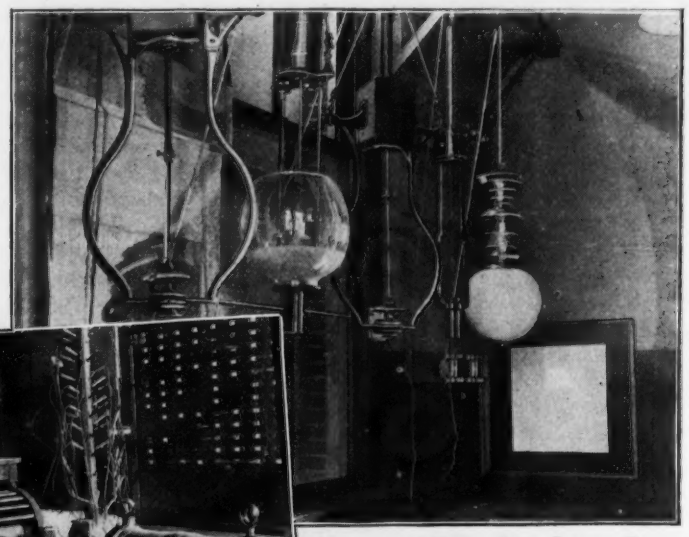


Fig. 11.—The Arc Lamp Rack and Projection Screen.

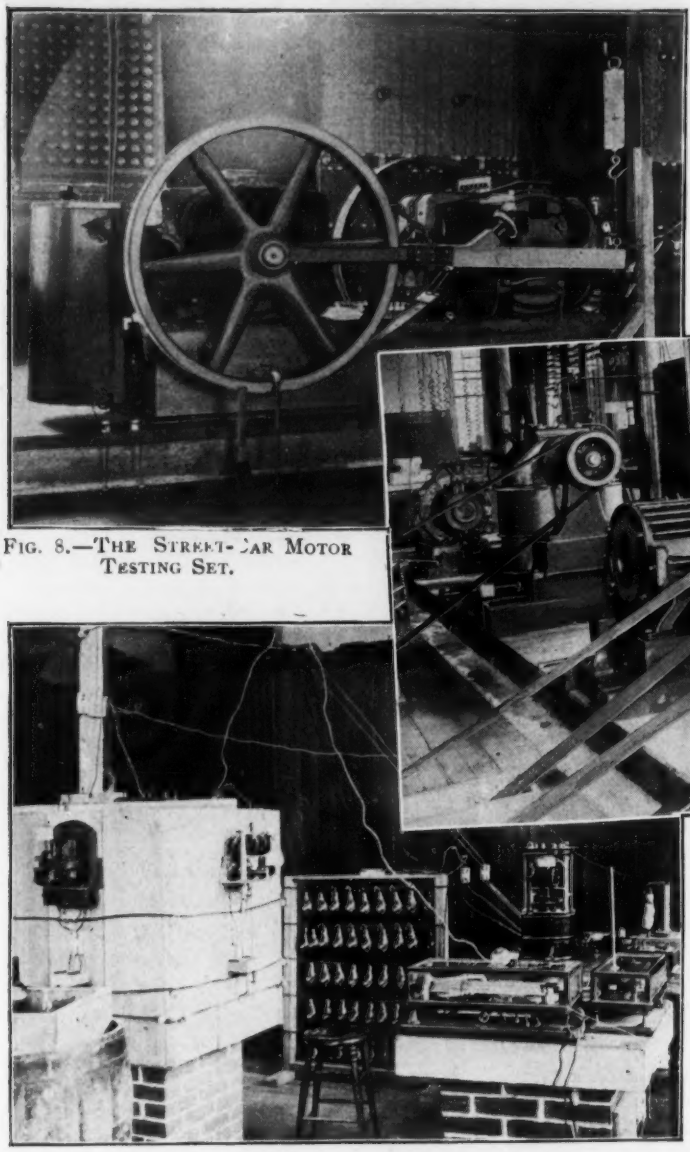


Fig. 9.—Some of the Direct-Current Machines.

Fig. 10.—A Meter Testing Room.

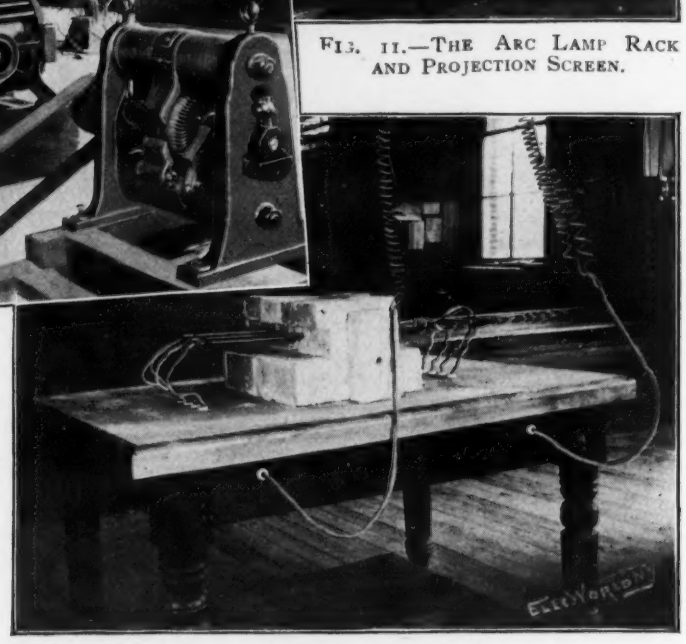


Fig. 13.—The Electric Furnace.

installed; this panel contains two indicating voltmeters, two indicating ammeters and two indicating wattmeters, all of the Thomson type. By the arrangement of the switches and plug connections of this panel, it is possible to connect either one of the voltmeters between any two of the dynamo leads, to connect either one of the ammeters in series with any one of the four dynamo leads and to connect either wattmeter so as to register the power in any circuit leaving the dynamo, without opening or in any way interfering with the circuits in operation. The combined equipment is therefore an ideal one for laboratory purposes, and possesses flexibility coupled with great simplicity, that adapts it excellently to the purposes for which it was designed.

Fig. 15 also shows the 500-volt 40-kw Jenney direct-current generator that is used for railway motor testing and power purposes. This is a valuable dynamo for the study of the regulation of direct-current machinery, owing to the fact that the length of the working air gap can be very readily varied by moving the pole pieces up or down on the vertical core. Some very interesting and valuable

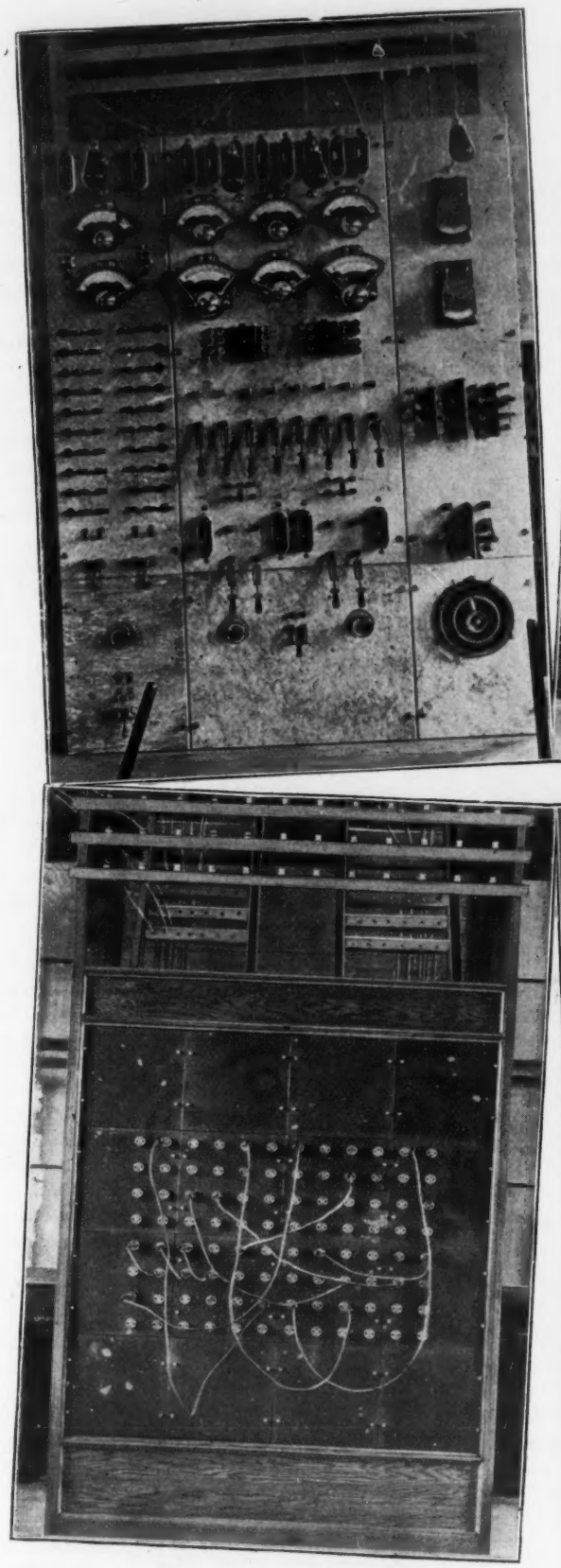


FIG. 16.—THE MARBLE SWITCHBOARD.
FIG. 18.—THE TRANSFORMER SWITCHBOARD.

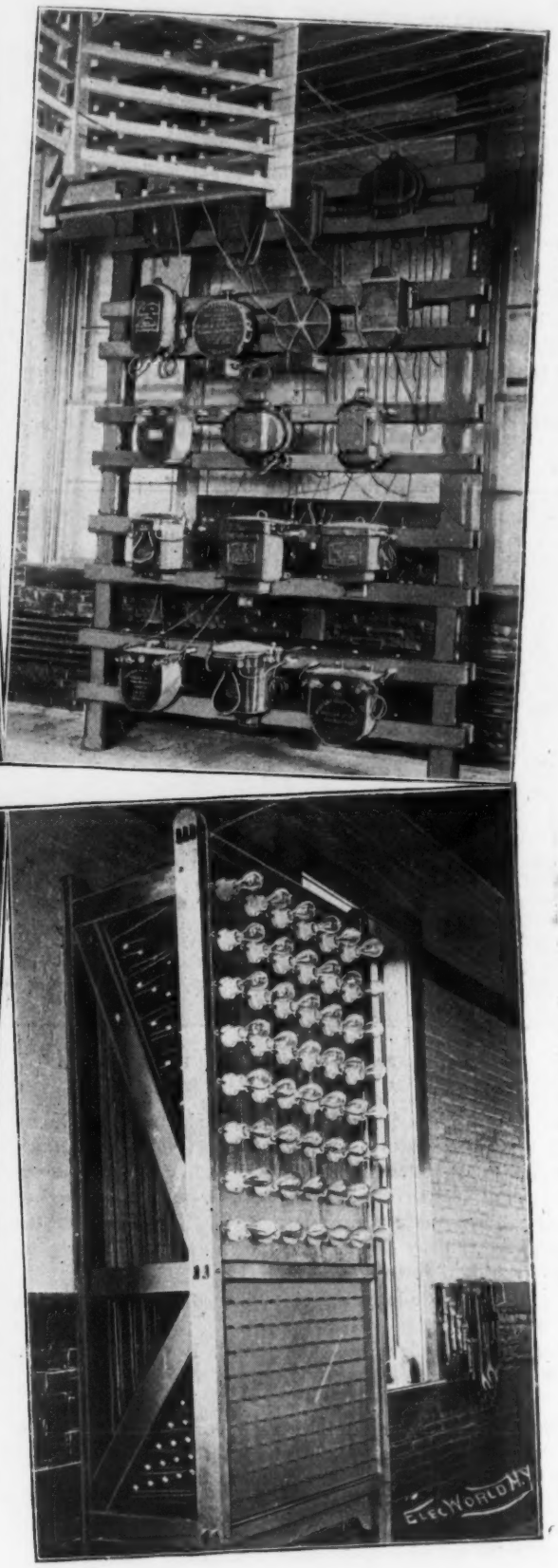


FIG. 17.—THE TRANSFORMER RACK.
FIG. 19.—THE HIGH VOLTAGE LAMP BOARD.

results have already been obtained in this way. This generator is controlled from the right hand panel of the switchboard, shown in Fig. 16, while the Slattery alternator is controlled from the left hand panel. The switchboard is made of blue marble and its fittings and back connections are thoroughly up to date.

The laboratory is especially well equipped for testing transformers. In Fig. 17 is shown the testing rack, on which seventeen transformers are mounted. The connections are arranged so that the primary and secondary leads are held apart by highly insulated supports a distance of 6 inches or over. The leads are then carried overhead to the transformer terminal switchboard shown in Fig. 18. This switchboard is connected with the general switchboard and the other alternating-current machinery by additional leads; it is also connected to the high-voltage lamp board, containing fifty lamps and capable of safely withstanding 5000 volts pressure. This board is used whenever it is necessary to employ non-inductive resistances in the primary circuits. It is very highly insulated.

A large number of transformer tests have been conducted in the laboratory during the past two years. There are over thirty transformers available for laboratory testing, one of 300 lights capacity, three of over 100 lights capacity and the other smaller. The most important tests at present in progress are the aging tests of a number of transformers of different makes and most improved construction. The practical engineering work of the students is not, however, confined to the laboratory. Within the last year the seniors have conducted tests on one mining electric plant,* on one steam power commercial direct-current lighting station, on one gas engine driven commercial two-phase alternating-current lighting plant, on the Lafayette street railway power plant, including the testing of the motors and car equipments.

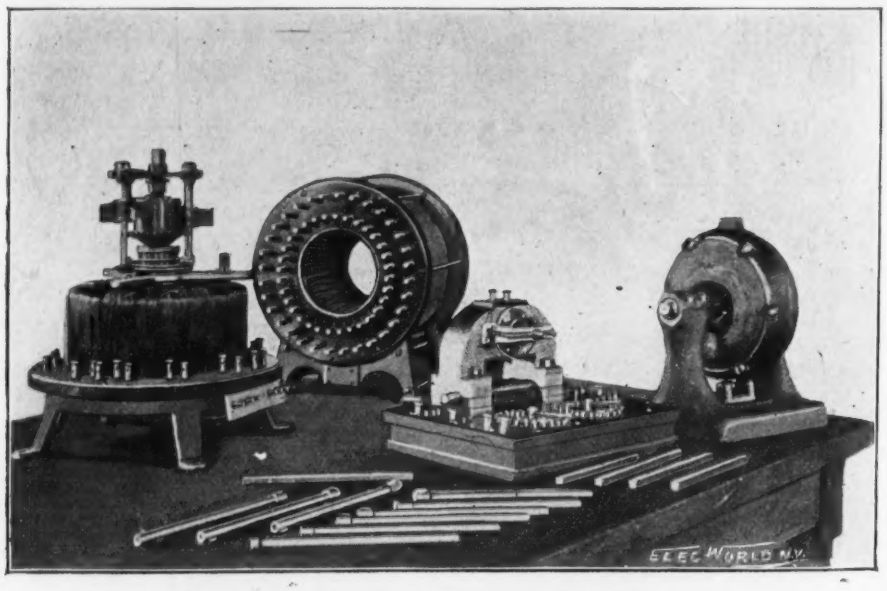


Fig. 12.—Apparatus Made by the Students.

The senior and junior students are also taken on inspection trips covering the principal plants and manufactories within the limits bounded by Milwaukee, Cleveland, Cincinnati, Louisville and St. Louis. These trips are taken in the spring of the year, and each year two or more of these cities are visited.

The perfection to which the engineering laboratories of Purdue University have been brought is due to the forethought and energy of the president, Dr. James H. Smart, in the early days of the development of technical schools. By persistent effort the laboratories have been kept in step with the rapid progress of recent years, and they represent to-day an advanced expression of the present development.

The department is under the direction of W. Elwell Goldsborough, professor of electrical engineering, and associated with him in the work of instruction of the department are A. Wilmer Duff, professor of physics; C. P. Matthews, associate professor of electrical engineering; E. E. Reynolds, W. N. Motter and J. W. Esterline, instructors in the electrical laboratories, and S. N. Taylor and H. G. Creelman, instructors in physics.

*See Electrical World, July 27, 1897.

Lewiston, Idaho, Long Distance Transmission.

A typical Western long-distance transmission plant is being installed for the lighting of Lewiston, the largest and wealthiest city in the State of Idaho.

The source of power is Asotin Creek, 10 miles distant in the State of Washington. Asotin Creek falls about 65 feet to the mile from its source in the Blue Mountains to its junction with the Snake River.

The water is ditched and flumed in open conduits for a mile and a half, when it is dropped through a steel flume to turbine wheels, 100 feet below.

The transmission line is of bare copper carried on Locke high voltage insulators, and has three transpositions. The line, en route to Lewiston, passes through Asotin City, the county seat of Nez Perces County, and step-down transformers are placed here for lighting and power distribution. For 5 miles the line follows the great Snake River Canyon, in which there are many motor services for raising water to the flats for irrigation purposes.

The power plant is built on a ledge of basaltic rock, 20 feet above low water, and will contain three 250-kw three-phase inductor alternators, working under 10,000 volts pressure at 60 cycles. These dynamos are made by the Walker Company, and are direct connected to New American 30-inch twin turbines, of cylinder gate pattern, making 450 revolutions per minute under 100 feet and 20 feet draught. Replogle relay governors are mounted on the wheel cases to govern the speed.

The switchboard is also furnished by the Walker Company, and is made of white marble, on which are mounted Keystone instruments. At Lewiston oil transformers of the self-cooling type step down from 10,000 to 1000 volts. Distribution to enclosed arcs, incandescents and motors is made on 1000-volt lines. The transformers are the latest type of Wagner construction.

Prof. Eleazar Darrow, of the Washington Agricultural College, is the consulting engineer. Mr. D. M. White is president and S. H. Reed secretary of the Lewiston Light Company, Limited.

Electric Distribution of Power at the Baldwin Locomotive Works.

From a paper presented by Mr. George Gibbs before the New York Railroad Club on "The Electric Distribution of Shop Power," the following facts concerning the system in use at the Baldwin Locomotive Works are taken. There are 215 motors in use, ranging from 2 to 50 horse-power each, with an aggregate capacity of 1930 horse-power. The total generator capacity is 700 horse-power, and the average horse-power shown at the switchboard is about 570, the load being quite steady. The force of workmen needed for inspection and repairs of the lines and the 215 motors, as well as ten arc dynamos and four generators, consists of two men, with the occasional assistance of a third. One of these men works solely on armature repair. The labor cost averages about $6 a day, and the material used in repairs is estimated at about $2 a day. The total maintenance and repair cost is, therefore, about $2,500 a year, or about 4 per cent. on the first cost of the plant. It is estimated that this is about the same as the maintenance cost of a mechanical system of power transmission. By the substitution of electric motors and the consequent removal of some shafting in the shops sufficient head room was obtained for compactly built electric cranes. This has reduced the labor involved in moving machines 50 per cent. or more, one incident being cited where four to six men do the work previously requiring forty, and do it more rapidly. One shop previously requiring 150 horse-power at the engines to drive the shafting alone now seldom requires more than 80 horse-power at the switchboard, notwithstanding the addition of a crane and several new machines. Two 100-ton cranes in the erecting shop are each driven by a 50-hp motor, their installation effecting an immediate saving of eighty men. A number of portable electric drilling outfits are also used. In the same paper Mr. Gibbs cites figures of loss with old-fashioned belting and shafting, one case being a planing mill of a Western Railroad, where 500 horse-power was indicated with the mill running as usual and 375 horse-power with all the machines idle.

Sectional Conductor Electric Railways—IV.

BY GEORGE T. HANCHETT.

ELECTROMAGNETIC SYSTEMS.

By far the largest class of sectional conductor systems are those which switch in and switch out the sectional rails by means of electromagnets which are supplied at the proper times by current either directly from the car or through its agency.

These systems necessitate in most cases more than one set of insulating rails or buttons in the roadway. Some of them use as many as three rails and a corresponding number of collecting devices. There is opportunity in such a system as this to exercise great and varied ingenuity, and hence many inventions have been patented.

The systems may be sub-classed as follows: First, those using interdependent switches—that is to say, where the action of one switch depends upon the closure of the one preceding it; and second, those in which the switches are independent of each other.

As has been stated, the car actuates the magnets in the trackway by supplying them with current. Under normal conditions the car is supposed to be receiving live current from the sectional rail beneath it, and when its collecting device impinges upon an inactive rail or button in front it thereby sends current into the electro-magnetic switch in the trackway, which then responds and the rail becomes live.

The normal condition of all the sectional switches leaves the sections dead, and it is therefore possible for the car to stand upon the trackway without any live section either under it or adjacent. In other words it has "lost current," and hence must possess an independent means for picking up its switches and starting the system. The usual means provided is a storage battery carried by the car. The current from this battery is sent into the switch coils by means of suitable connections whenever the car starts.

In Fig. 49 is shown one of the earliest and best known of these devices. Three rails or sets of buttons are provided. Two of them supply the car with current at such times as the switches are closed, the third is a storage battery circuit. The switching magnet is provided with two coils and receives its initial current from the storage battery through the fine winding.

The other bobbin is connected in series with the supply button, and hence the motor current holds the switch up after it has once been closed. It may be remarked that one of the sets of collecting buttons can be done away with and the track utilized as a return.

An important feature in this system consists in the fact that the switching magnet has a coil which is in series with the main circuit. It therefore follows that the magnet will not drop its switch until all current in that coil has ceased, at which time, there being no current to break, there can be no arc. This is the most effective way to produce a non-arcing switch, and it is employed in many different systems.

A disadvantage of this system is that the duty of the storage battery is continuous, and that it requires to be recharged frequently. This latter feature is most objectionable in large roads of say 1000 cars. If each car uses a set of five batteries fully 10,000 cells will be needed, a very expensive outfit to purchase and maintain. It is highly desirable that the storage battery be so connected to the car circuits that it is being continuously charged, thereby minimizing the amount of attention it requires, and moreover the power house current should be utilized to pick up the switches and the storage battery brought into play only when the car has lost current. In this way the duty on the battery is very light, and it being continually

FIG. 49.

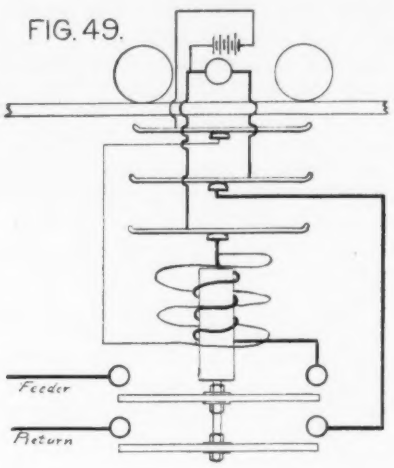


FIG. 51.

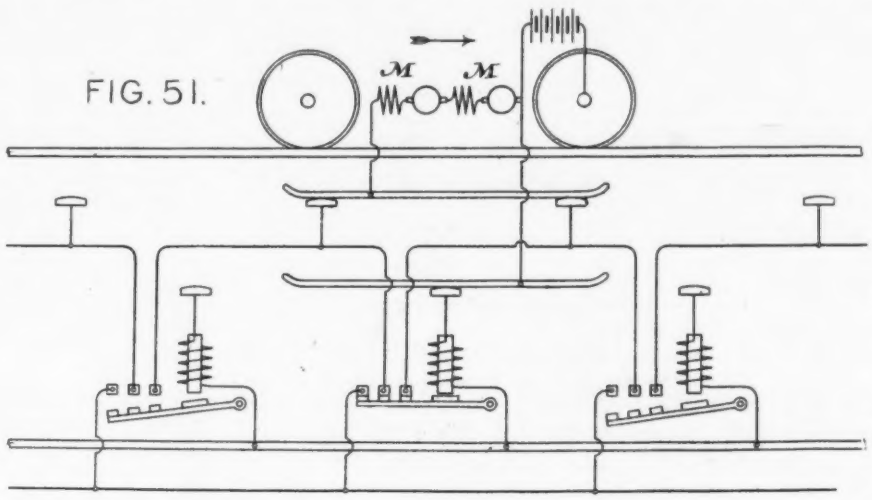
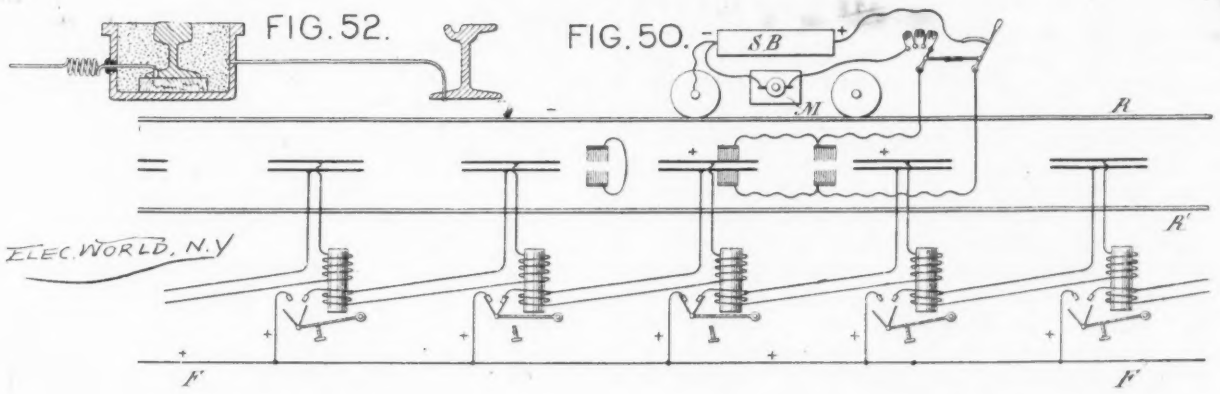


FIG. 52.

FIG. 50.

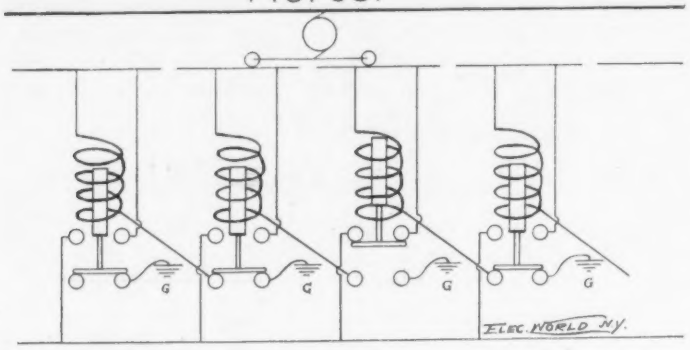


charged it becomes a device of sufficient permanency to admit of its being used in railway service.

A system in which these features are realized is shown in Fig. 50. It is of the interdependent class. Each switch, it will be noted, carries two coils, one of which is supplied by current passing through the contacts of its predecessor. The storage battery used here is connected directly across the motor terminals, and is therefore continuously charged. Moreover, as the shoes proceed along the trackway they supply the necessary current to the switches ahead without calling the storage battery in play. The disadvantage of this system is that the storage battery requires enough cells to have the same E. M. F. as the line. The commercial railway pressure is 550 volts, necessitating at least 275 cells per car, a decided disadvantage. Of course, being thus large, the storage battery can drive the car in the absence of power house current, a very useful feature in rounding curves or crossings, but such an arrangement makes the system susceptible to all the evils of a regular system of storage battery traction. The sectional system has troubles enough without assuming in addition the difficulties of storage battery traction. Either alone is sufficiently hard to exploit; the combination is fatal.

In Fig. 51 is shown another system which obviates the difficulty already cited. The storage battery, which consists of but a few cells, is connected from the ground circuit in multiple with the switch magnets. It is therefore charged at such times, as the current in the magnet is great enough to produce a sufficient difference of potential at its terminals. The power house current is depended on to actuate the switches excepting at the start, when the storage battery is called into play. The system requires two sets of contact buttons, or in lieu thereof two sets of rails, and the switches are interconnected, a somewhat undesirable device, as it adds to the cost of wiring. Moreover, when the switch breaks current there is a considerable arc at the jaws, and especially is this the case if the switch ahead happens to be out of order. In this case the fact that the magnet bobbin is in series with the car is of no avail, because the contacts receive current from other sources than through the magnet. In this system the difficulty of arcing has been met by means of a magnetic blow out, not shown, which is said to be quite effective.

FIG. 53.

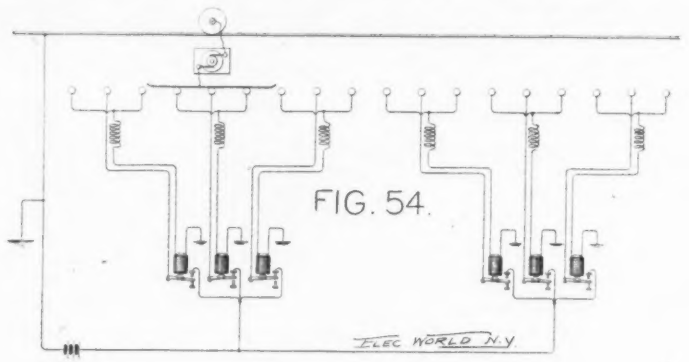


In the two systems just cited the leakage current is liable to stray ahead of the car and actuate the switches in advance. In Fig. 52 is shown an ingenious device for obviating difficulties arising from this cause. The rail or button is surrounded with a metal receptacle, which is connected to the ground. If the leakage current proceeds from a live conductor it immediately finds a circuit in the adjacent edge of the metallic receptacle, and should it succeed in evading that most obvious path to ground it will fail to enter one of the studs connected to a switch magnet, because it will first encounter the iron receptacle surrounding it. This device doubly protects a system against this variety of accident. It is ingenious and should be very effective.

A system employing but a single set of rails is very desirable, on account of the diminished cost. An ingenious arrangement is shown in Fig. 53, but one which is susceptible to some very peculiar faults. The traveling shoe receives current from one rail and supplies it to the rail in advance, from which it is passed through the switch and to the ground via the lower contact of the switch next removed, which in the open position will permit such passage of current. The switch magnet which is thus receiving current immediately closes its circuit and breaks the ground return of its predecessor, which accordingly drops. The operative condition is therefore that, for a switch to close, its mate immediately in advance must be in a lower position to give it a ground connection. If we attempt to reverse the combination it follows that in order to raise a switch its immediate predecessor must be dropped. Inasmuch as the latter is supposed to be supplying current to the car it cannot be in a lower position and therefore a switch in advance cannot be actuated. Thus the car will not run backward, and any attempt to do this will simply leave a single live section in the roadway and coast the car back upon dead rails, which it is absolutely impotent to charge. Moreover, if a single switch fails to operate all those in advance will also fail, and the car will leave a single live section in the roadway and coast forward on to sections that it is powerless to energize. Street car systems can be made commercial and yet not be capable of backward motion, as the cable system has demonstrated, but as there are scores of other sectional conductor systems in which the reversible feature exists, such an arrangement as that just depicted can never compete.

Another system which employs a single set of buttons in the roadway is illustrated in Fig. 54. A long skate is used, sufficient to bridge four buttons at a time, and owing to the fact that so many buttons are bridged at once little if any advantage would be gained by substituting an equivalent rail and brush device. Every fourth button is connected to the feeder main via an automatic switch, and the remainder of the buttons all form paths through the actuating bobbin of the automatic switch to earth. These bobbins are so disposed in the roadway that the two which are connected to the automatic switch are on either side of the button which that switch feeds. The operation of the system is obvious. Assuming that the car is traveling to the right and is receiving current, it follows that when the contact shoe strikes a magnet button it will energize that magnet and charge the corresponding supply button with which the shoe will presently make connection. It is further evident that a feeder button will be charged as soon as the shoe strikes upon the button preceding and will not be disconnected until the shoe leaves the button in advance. The car must therefore be longer than the shoe by a distance equal to twice the distance between the buttons. It appears also that the switch does not disconnect the stud until all current at its contacts has ceased. It is therefore non-arcing. Unfortunately, however, there is no provision for picking up the switch independently of the power house current. The actuating bobbin must either be a high voltage or must be supplied with a resistance as shown, and in any event will require a high voltage to operate it, which cannot be conveniently supplied by the car and which, in this case, would be difficult to connect were it so supplied.

A system which seems to have avoided most of the difficulties of electro magnetic closure, and uses but a single set of third rails, is illustrated in Fig. 55. The automatic switch carries two bobbins, one of fine and one of coarse wire. The fine wire bobbin is connected to ground at one end and to the sectional rail at the other. The coarse wire bobbin connects the sectional rail to the feeder main when the switch is closed. The action is as follows: The forward collecting brush first feeds current into the third rail through the fine wire bobbin to ground; the switch rises and by means of a bell crank lever on the top breaks the fine wire circuit. The switch, however, does not fall, for current is being supplied to the motor by the coarse wire circuit the moment that the jaws of the switch close, nor will it fall until the motor has ceased to draw current from that section. It is therefore non-arcing. In case the car loses current and fails to pick up its switches, independent provision is made by a small motor dynamo, which is connected across the motor terminals on the high potential side, while the low potential side is connected to a few storage batteries. Under normal conditions the high potential side acts as a motor, driving the low potential side as a dynamo, charging the battery and exciting the fields of both machines. If, however, the line current fails, the two ends of the motor



dynamo exchange functions. The battery drives the low potential side, and the high potential side, now a dynamo, generates high potential current to actuate the switches and keep the car lamps always lighted. A suggested objection to this system is that there are intervals when the motor dynamo is short circuited by the railway motor, but it appears that this objection is not valid in practice, because that condition occurs at the instant while the switch is in the act of closing, which is exceedingly brief, and moreover can be largely overcome by properly controlled connections.

Another system which might be called electromagnetic, but involves the principles of traveling closers, is shown in Fig. 56. The car takes its current from a set of sectional conductors, underneath which there is provided a trackway in which travels a circuit closer driven by a motor. The salient point in the invention lies in the device which is intended to keep the traveling closer always under the car. The motor on the traveler is a series motor with two field coils. One brush is connected to the feeder main and the cur-

rent passes from the other brush through one field coil or the other, according to the direction in which the traveler is to be driven. Assuming the car to be going toward the left and in the direction of the arrow, the traveler assumes the position shown. If the car attempts to slow down the traveler runs ahead, but presently begins to feed current through its other field magnet through the contact 27. This reverses the traveler motor and quickly brings the traveler under the car again. Should the motorman shut off his motor completely, however, there is nothing to prevent the traveler coasting away from the car, or vice versa.

From the foregoing descriptions the writer believes that the following conclusions can be safely drawn: Of the three general divisions the mechanical closer is inadmissible if exposed devices are placed in the trackway, and, if protected by a conduit the cost effectively shuts it out of the competition. The systems of magnetic closers, while a great improvement over mechanical closers, do not appear to be likely to control the commercial possibilities that are open to the electromagnetic systems, owing to the fact that they are less flexible. The switching devices must be placed in certain positions regardless of conditions, in order that the operating magnet can act upon them. No traveling closers have been patented that are practically operative, though most of them are ingenious and theoretically perfect.

The sectional conductor system has been exploited in actual practice in many places, and the experiments that have been made have conclusively demonstrated that there is no practical difficulty whatever in maintaining a live rail or button continuously under the car. The popular idea of immense leakage is a misconception. Even if a long extent of track were covered with water it is hard to find commercial instruments that would measure the leak. The difficulties which seem to have caused the downfall of the hopes of many experimenters have been confined almost exclusively to the method of switching the sectional conductors, and if a reliable system of automatic switching is secured the sectional conductor system becomes an assured success. This is where the electromagnetic switches have the advantage. They can be placed in banks in large and easily inspected vaults. They can be securely sealed up in cases, of which Fig. 57 is a good example. This case is in the form of a diving bell, the mouth of which is closed by a deeply grooved plate, in which a lip projection on the edge of the bell fits. This groove can be filled with oil or some other moisture excluding liquid. Such a switch could operate without interruption in a flooded vault, for the water could not reach its contacts or coils.

The electromagnetic system, it appears to the writer, will reach success by the use of large vaults, each containing the switches for long reaches of track. The switches should be simple in design and reliability should be the first consideration. The vaults should be easily and frequently inspected, and an extra switch or so should be provided in each vault, so that a disabled or damaged switch could be at once replaced by the inspector. To facilitate this operation the switch should be easily connected and disconnected. This inspection will render the success of the system moderately certain, and in the meantime all of the difficulties involved will appear under the eye of the inspector and will be taken note of by the inventor and eliminated. The switch will thus be brought to a degree of periection such that it can be entrusted to take care of itself in smal vaults in the trackway. The auxiliary wiring which large vaults demand will then be done away with and the cost per mile should be less than that of a well constructed overhead system. In Fig. 58 is shown a diagram of a double track provided with single sectional rails and vaults placed at proper intervals. It will be noted that the amount of auxiliary wiring is practically insignificant.

We are now in a position to consider the financial possibilities of a successful sectional conductor system. The same track, the same feeders and the same equipments are necessary as in the case of an ordinary trolley system. The overhead copper wire and the labor of its installation practically balances the cost of the third rails or buttons, provided a single set is employed. We then have to balance against each other the cost of vaults and vault switches against span wires, poles and settings. The price of a good steel trolley pole will buy many vault switches. Freight charges are less, which is also true of labor of installation. The conclusion seems to be that a sectional conductor system of some kind is coming. It has been exploited before it was perfected, and many failures have sunk the confidence of the moneyed electrical investors, but, like the storage battery, the sectional conductor system is repeating history.

FIG. 55.

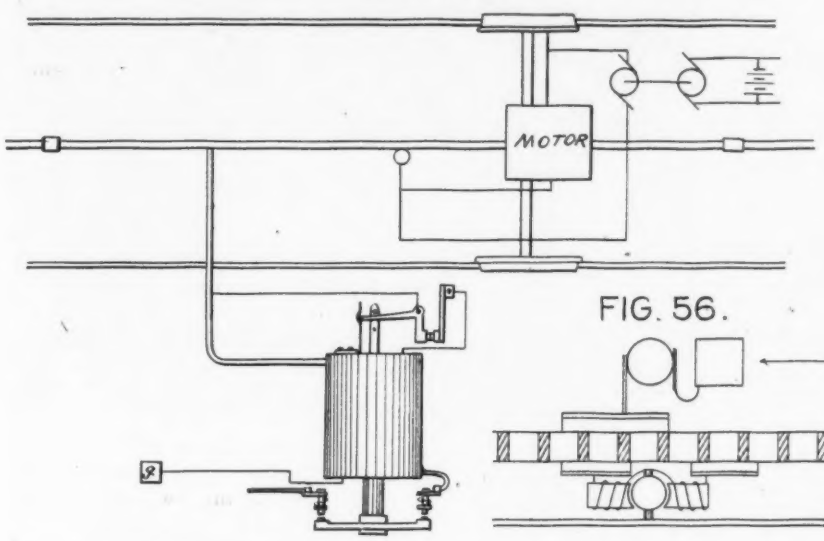


FIG. 56.

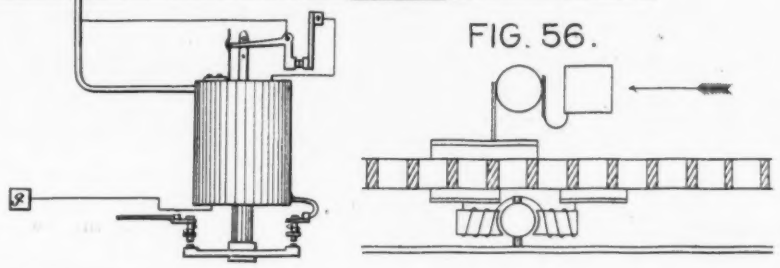


FIG. 57.

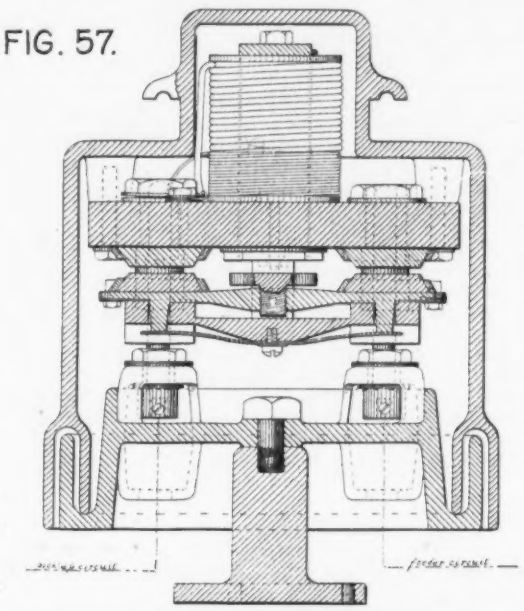
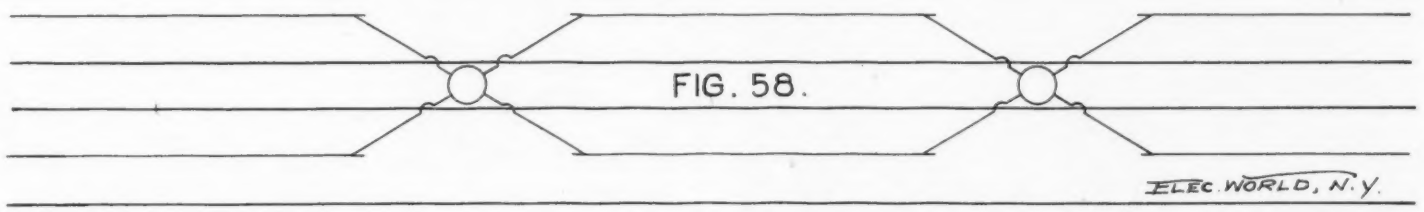


FIG. 58.



ELEC. WORLD, N.Y.

Complete Train Lighting System.

The new "Pioneer Limited," on the Chicago, Milwaukee & St. Paul Railway between Chicago and the Twin Cities, is equipped for electric lighting with a dynamo and engine in the forward car, and storage batteries under each car. The latter are charged while the dynamo is running, and are useful when the train is divided or for any other reason the dynamo power is cut off.

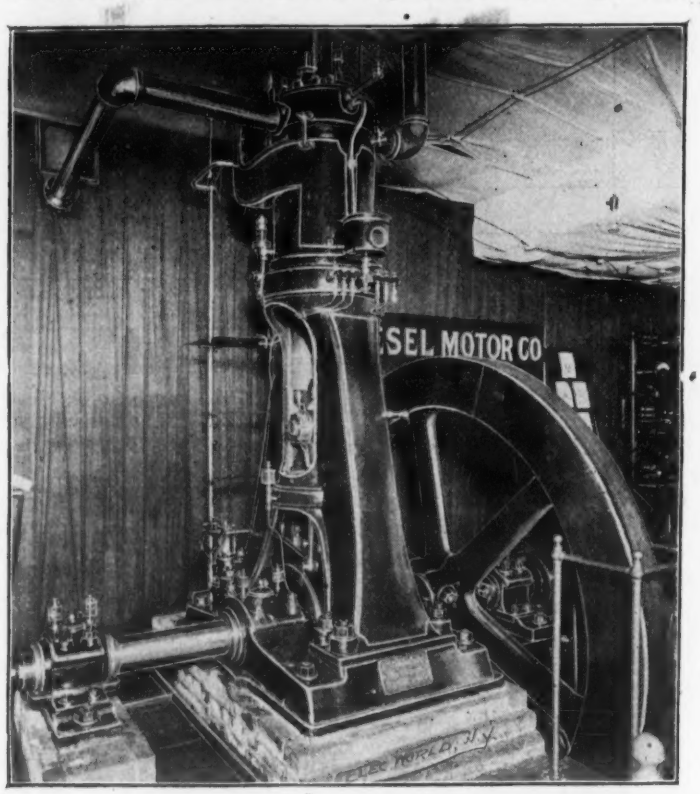
The Rebuilding of the Shops of the University of Kansas.

The electrical engineering machine shops of the University of Kansas were struck by lightning and completely destroyed recently. Twenty thousand dollars in engines, dynamos and machinery were lost. Mr. George A. Fowler, president of the Fowler Packing Company, Kansas City, Mo., will donate new shops for the department of electrical engineering. These will be modern in every respect, built of stone, and will be over 200 feet in length, two and one-half stories high and equipped with some $30,000 worth of most modern machinery and electrical appliances.

It is believed these shops will be superior to any west of the Mississippi River, and the Board of Regents will name them in honor of the donor. There are 1100 students in the University of Kansas, of which number 100 are in the electrical engineering department.

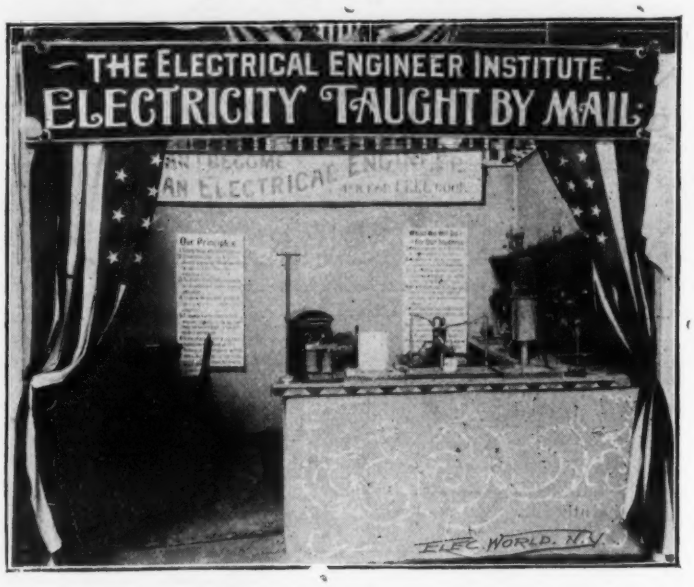
At the Exhibition.

THE DIESEL MOTOR.—The newest thing in the internal combustion gas engine line the world over is shown at the exhibition by the Diesel Motor Company of America, whose offices are at 11 Broadway, New York City. An analytical discussion of this motor was given in The Electrical World of February 19, 1898, but a brief review of the interesting operation of this engine may not be out of place here. The thermo-dynamic action is quite similar to the ideal Carnot cycle, there being no explosion. The engine, which works on a four-stroke cycle, compresses only air, and the fuel (kerosene oil being used at the exhibition) is introduced during the first part of the forward power producing stroke of the piston, the point of cut-off being fixed at about 8 per cent. of the stroke. The compression, which is very high, reaching some 525 pounds in the engine shown in the exhibition, is practically adiabatic, the expansion line to the point of cut-off being closely isothermal, and from that point to the point of release adiabatic. Fuel is introduced every other revolution, the cylinder being single acting, and governing is effected by varying the amount of fuel and consequently varying the mean effective pressure, giving cards very closely similar to those of quick cut-off steam engines. The quantity of air taken per stroke is not varied. A card taken with a varying load is shown herewith, the beautiful expansion curves on the different loads running almost down to the atmospheric pressure, and the uniform compression curve for all loads being perfectly shown. The engine shown at the exhibition was built by the Maschinenbau Actien Gesellschaft, of Nürnberg, Germany, and was imported by the American company. The machine work on this engine is most perfect, and in spite of the enormous compression used, namely, over 500 pounds to the square inch, there is no audible noise about the running of the engine except the clack of the cam valves. The fuel is injected as a spray by means of a high pressure maintained in an auxiliary tank, this pressure being greater than that of compression in the engine, and varying from 625 to 700 pounds per square inch. This auxiliary tank storage is also used to start the engine. The oil pump supplies a definite amount of oil for each active stroke sufficient for the maximum load of the engine, and the governing is effected



The Diesel Motor.

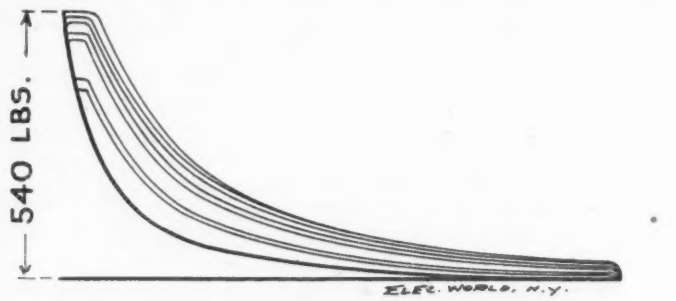
by opening a bypass at a percentage of the oil pump stroke proportional to the load, a governor operating the cut-off of this bypass valve and thereby varying the effective stroke of the oil pump. The oil and air pumps (the latter supplying the storage cylinder mentioned above) are worked by a rocker arm from the crosshead as are the air pumps in standard types of marine engines. The engine shown at the exhibition is rated at 20 horse-power, the cylinder being 10 inches in diameter by 16-inch stroke. The cylinder is water-jacketed, and is fed by poppet valves in the cylinder head actuated by cams. The lines of the accompanying card show the perfection of the valve motion. The weight of the engine is, of course, somewhat high compared with that of a steam engine of the same output, owing to the fact that there is but a single active stroke during two revolutions. The engine shown weighs about 4½ tons, ex-



Booth of Electrical Engineer Institute.

clusive of the fly wheel, which is 8 feet in diameter and weighs about 4500 pounds. This great moment of inertia is necessary for close speed control on account of the large interchange of energy between the piston and the wheel. The crank pin of the engine is cooled by a circulation of water through the main shaft. The engine is direct coupled to a C & C generator supplying lights, the load being about 110 amperes at 110 volts. The effective stroke of the engine is shown on the voltmeter by a beat of about two volts.

THE ELECTRICAL ENGINEER INSTITUTE OF CORRESPONDENCE INSTRUCTION has an exhibit on the main floor, which is the centre of attraction to both the layman and expert. This enterprising institution has fitted up a most complete laboratory at its booth, and nightly demonstrations are given with the various apparatus. The experiments include almost all the important electrical manifestations, methods of generating electricity and many of the practical applications. Much interest is taken in these experimental demonstrations. Mr. Joseph Sachs, of the institute staff, is in charge of the labora-



Regulating Card, Diesel Motor.

tory. The experiments range from the elementary demonstration of the deflection of a needle to the more complex phenomena of the electric furnace and electro-chemical effects. Particularly prominent, however, are the production of calcium carbide, the electric water-pail forge, electric welding, electric arc metal working and the experimental demonstrations of the principles upon which the

motor and dynamo are based. Popular lectures on electricity, with experiments, will be delivered by Mr. Sachs on a larger scale in the concert hall during the two remaining weeks. These lectures are free to all, and are to be regarded as a contribution to popular education by the institute Mr. Herman A. Strauss, general manager of the institute, and an able corps of assistants, including Mr. Willard M. Miner, Mr. Edward Hyans and Mr. M. Cushner are at the exhibition every evening.

THE PRINDLE PUMP COMPANY, 120 Liberty Street, New York, shows a line of motor-driven centrifugal pumps, all coupled direct to Excelsior motors.

TWO KOSMIC OIL FILTERS.

The largest of these is a 12-inch size capable of handling 4000 gallons per minute against a head of 35 feet. It is driven by a 40-hp motor. The pumps have a double suction on both sides of the runner balancing all end thrust. They are also fitted with two swivels, whereby the suction and delivery can be independently run off at any angle. The casing is also provided with a removable side plate of sufficient diameter to allow the ready removal of the runner. Two small pumps are fitted with automatic starting devices, built by the Automatic Switch Company, of Baltimore. One of these is a mechanically operated rheostat handle actuated by the motion of the motor, a centrifugal device serving to catch the rheostat arm in starting and wind it to the short circuit position, and to release it when the motor stops, allowing it to jump to the full resistance position. Another pump is fitted with a float controller, with quick-break switches and a solenoidal control of the rheostat.

BABCOCK & WILCOX BOILER.

THE STANDARD FIREPROOFING COMPANY, 39 Cortlandt Street, New York, makes an exhibit of sample lengths of 3, 4 and 6 duct conduits. The conduits made by this company are of earthenware.

THE KOSMIC OIL FILTER is exhibited by the Kosmic Oil Filter Company, Easton, Pa. This machine is a combined separator and oil filter, the water being separated from the impure oil before purification. The filter is divided into two parts, which enables one part to be cleaned without interfering with the other. The oil is filtered through cork. A gauge glass on the side of the filter shows the purity of the oil delivered. This filter is useful with new oil as well as waste oil, and is said to operate well no matter how dirty the waste oil may be.

ON THE MAIN FLOOR is noticed an odd looking vehicle, which is stated to be the "Pioneer Electric Motor Car with Underneath Contact." It was used in Denver, Col., in 1885. This car constitutes the personal exhibit of Prof. S. S. Short. The car body consists of a wooden box 6 feet long, with a wooden seat along each side. The car has no roof. The four wheels are of the type used on railway hand cars, and are journaled on blocks of wood which support the body of the car. Underneath the car is a small Short motor, the power of which is transmitted to the forward axle by means of single reduction gearing. The current is conveyed to the motor and returned from it by two No. 8 bare copper wires laid on the ties between the rails. The wires are soldered to the top of small bell-shaped insulators. The controller is in a small enclosure at the front of the car. The pioneer vehicle is named the "Joseph Henry."

THE SAMSON CORDAGE WORKS, Boston, Mass., exhibits, in a show case, samples of signal, trolley, arc lamp cords of various styles and finish.

MR. E. T. SCHOONMAKER, Fordham, New York City, has a unique exhibit which may be classed among the most interesting in the Garden, viewed from a scientific and educational standpoint. He illustrates magnetic phenomena and magnetic lines of force by means of iron filings and some excellent specimens of work in this line are exhibited. After the filings have arranged themselves on the surface they are "set," thus giving a permanent record. One of the most interesting features of the exhibit is the "floating magnetic field." The box containing this specimen is about 12x14 inches and 4 inches deep. Several plate glasses are set in the box horizontally, three-eighths of an inch apart, and between the plates some iron filings are sprinkled. The box is placed on the poles of a magnet, and the iron filings arrange themselves in accordance with the well-known laws of magnetism. The result of this arrangement is that the magnetic field of force is completely shown. The usual method of illustrating magnetic lines of force by means of iron filings gives simply a single surface indication, but by Mr. Schoonmaker's "floating" method depth is also shown, and the result is an accurate delineation of the magnetic field of force as it radiates in every direction from the poles. Mr. Schoonmaker illustrates the formation of magnetic lines by means of filings before the eyes of the spectators. On a platform in the centre of the booth is a large plate of glass. The glass rests on the poles of a powerful electromagnet. Iron filings are sifted from above, and they drop on the surface of the glass and arrange themselves in radial lines, thus illustrating the lines of force.

THE BABCOCK & WILCOX COMPANY has installed the boilers in use in the power generating equipment in the basement. There are two of these, each rated at 265 horse-power at 220 pounds pressure. They are of the standard Babcock & Wilcox type, and are two of the large lot aggregating 16,000 horse-power, being built for the Metropolitan Street Railway Company for use in its new multiphase central power station now building in New York City. The boilers are of the inclined header type, and outside of the tubes, which are of charcoal iron, are entirely of open-hearth steel. The drum plates, of course, are rolled, the headers, the caps, the dogs and all the minor details being entirely of forged steel. The forged header is still a marvel to the steel worker on account of the complexity of its curves. Steam is supplied by two Worthington duplex direct acting pumps.

THE AMERICAN WATCHMAN'S TIME DETECTOR COMPANY, 234 Broadway, New York, has an exhibit of electric clocks, watchman's clocks, employees' time recorders. The company's electric time system is illustrated. Some of the clocks shown are very handsome in finish. On the wall at the back of the booth are seven small clocks in a row, showing the time at Manilla, Hong Kong, London, Madrid, Cape Verde, Havana and Porto Rico.

THE DOWD ELECTRIC COMPANY, 53 State Street, Boston, Mass.,

PRINDLE PUMP COMPANY'S EXHIBIT.

exhibits its electric headlight for bicycles. A small dynamo is attached to the front fork of the wheel, the rubber covered armature bearing on the rubber tire of the front wheel. It is evident, therefore, that when the bicycle is in motion the dynamo is generating current. A small electric lamp and reflector are set on top of the diminutive dynamo, and give a brilliant light when the wheel is in motion. The whole thing is only 5½ inches high by 2¼ inches wide and 1½ inches deep, weighing when fully fitted but 28 ounces. It is stated that when the bicycle is moving even at a very slow rate a steady light is produced. The light may be raised so that the rays will be thrown at any desired angle either directly before the wheel or so as to light the road ahead.

THE DE LA VERGNE REFRIGERATING MACHINE COMPANY, New York, makes an exhibit of the Hornsby-Akroyd safety oil engines. The largest of these shown is a 32-hp machine designed to run at 170 r. p_s m. A smaller 4-hp machine is shown in operation, belted by a link belt to a C & C dynamo running under load. Two 1½-hp vertical machines are also shown. The fuel used in these engines is kerosene oil, and with 140° test, the average consumption of which is stated to be about 1 pound per brake hp-hour. The engine, which has a single acting piston, runs on the Otto cycle with an explosion every two revolutions, the governing being effected by varying the amount of oil in each charge. A constant amount of air is always taken, and no special igniting device is used whatever. At the head of the cylinder there is a hot retort, in which the oil is sprayed and vaporized. On compression the air is forced into this, and the mixture is ignited by the walls of the retort, the starting of the engine being simply effected by heating the retort from an outside source. The supply of air is the same at any and all loads, the governor affecting a bypass valve on the oil supply. The compression is 40 pounds to the square inch. The oil is stored in a tank in the base of the engine. These engines have been supplied in considerable numbers to the United States Government for lighthouse and fortifications searchlight work, as well as for operating fog signaling compressors.

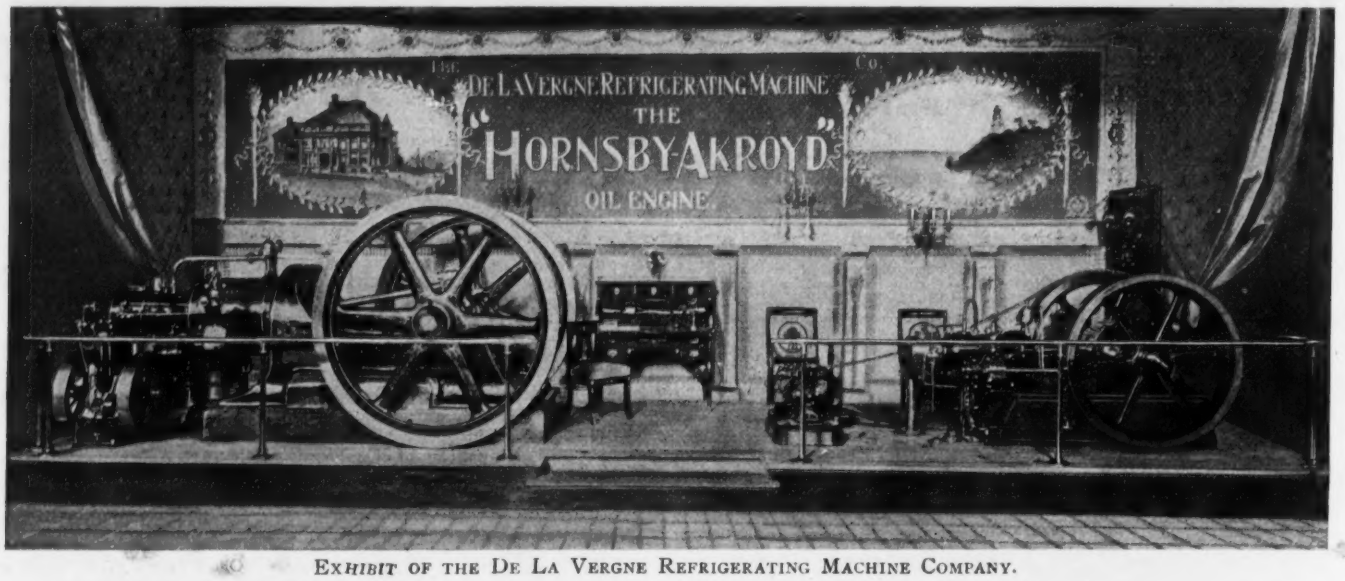


Exhibit of the De La Vergne Refrigerating Machine Company.

THE WALKER COMPANY makes a most complete exhibit beside the special conduit railway equipment described in The Electrical World of May 14. The leading feature of this exhibit is the street car apparatus, the most interesting part of which is the heavy McGuire truck for double truck cars, fitted with two Walker 20-L motors for heavy suburban or elevated service. These motors have a capacity of 150 horse-power each, thus giving with two such trucks a locomotive capacity of 600 horse-power to a single car. One peculiarity of this equipment is the fact that in spite of the power transforming plant within it, it is practically no larger either in height or wheel base than standard trucks for ordinary coaches, the parts being perfectly adapted for the space. A Peckham truck is fitted with two 4-A motors of a capacity of about 25 horse-power. The wheels of this equipment are off the floor and the motors are shown in operation, controlled by a solenoidal blow-out controller, which attracts no little attention, being exhibited in action with its cover removed. A complete set of the parts is also on show. The arrangement of the reversing switch for cutting out either one or the other of the motors in different positions is most effectively shown by this combination. The Peckham centre bearing swing bolster, maximum traction truck is shown with a 25-hp motor in place. A 50-kw Walker alternating generator is shown. The peculiarity of this alternator is the fact that the armature is the outer member, the fields re-

Main Exhibit of the Walker Company.

volving and being excited by a single field winding concentric with the shaft. The field winding is composite, the series coils being supplied by a rectifier. Two railway generator panels are shown fitted with Weston instruments, I. T. E. circuit breakers, triple grid-field rheostats made by the Ironclad Rheostat Company, Westfield, N. J.; Garton lightning arresters and other fittings made by the Walker Company. The new design of the Walker pivotal trolley base is also shown fitted with trolley pole and Grover trolley head. Perhaps the newest thing in the exhibit is the integrating direct current ammeter, this machine appearing at first sight to be simply a copper disc and permanent magnet braking device, so widely used in the ordinary integrating meters. Spread out flat upon this disc, however, there are three coils connected with a long, slim three-part commutator through which the current to be measured is introduced. These coils react upon the permanent magnets, which also serve to generate Foucault currents in the disc brake, to give a torque proportional to the current flowing. The wire being well distributed on the disc gives a torque fairly uniform at all angular positions of the disc. The instrument is an interesting one, owing to its extreme simplicity. The Walker Company also shows an enclosed lamp for either multiple or series circuits, the regulating mechanism of the lamp consisting of a chain fastened to the upper carbon holder, running over a sprocket wheel and partially counterweighted and a magnetically actuated clutch operating on a pulley coupled to the sprocket wheel.

THE MONTAUK MULTIPHASE CABLE COMPANY, New York, occupies a booth on the main floor. Its exhibit includes several rolls of multiphase wire of various sizes for different uses, such as signals, telephones, electric lighting, etc. The practical operation of these wires as protectors against the entrance of burglars, and as a fire alarm is practically illustrated by Mr. Lucien W. Jenney, who is in charge of the exhibit. To show the operation of the system as a burglar alarm, Mr. Jenney simply cuts the wire with a pair of pliers, and the result is the ringing of the bell on the annunciator, which also shows the location of the break. The fire alarm feature is illustrated by the application of a lighted match to the cable. The temperature thus raised to the danger point causes a short circuit in the cable, the sounding of an alarm and at the same time an indication on the annunciator of the location of the dangerous heat. These indications facilitate prompt and proper action in either case. These cables are not only useful for protection of property from fire and burglars, but, as has already been pointed out in the columns of THE ELECTRICAL WORLD, they may be used in buildings for all interior electrical work. The thermostatic feature is added to all the cables manufactured by this company.

THE INDIA RUBBER & GUTTA PERCHA INSULATING COMPANY, Glenwood, N. Y., has a showcase in a booth near the main entrance, containing samples of cables manufactured for actual service. There is a long line of samples of insulated cables of all sizes, among the most prominent being a concentric three-conductor cable, each conductor having an area of 1,000,000 circular mils. Another sample of a cable contains a single conductor of 4,000,000 circular mils, the cables represented ranging from 250 circular mils to this large area. Beside these are shown sections of all the bus bars used in the power house of the Niagara Falls Power Company and sections of submarine cables made for the United States Government. The attractive appearance of the enclosure is enhanced by potted palms, artistically arranged in the corners.

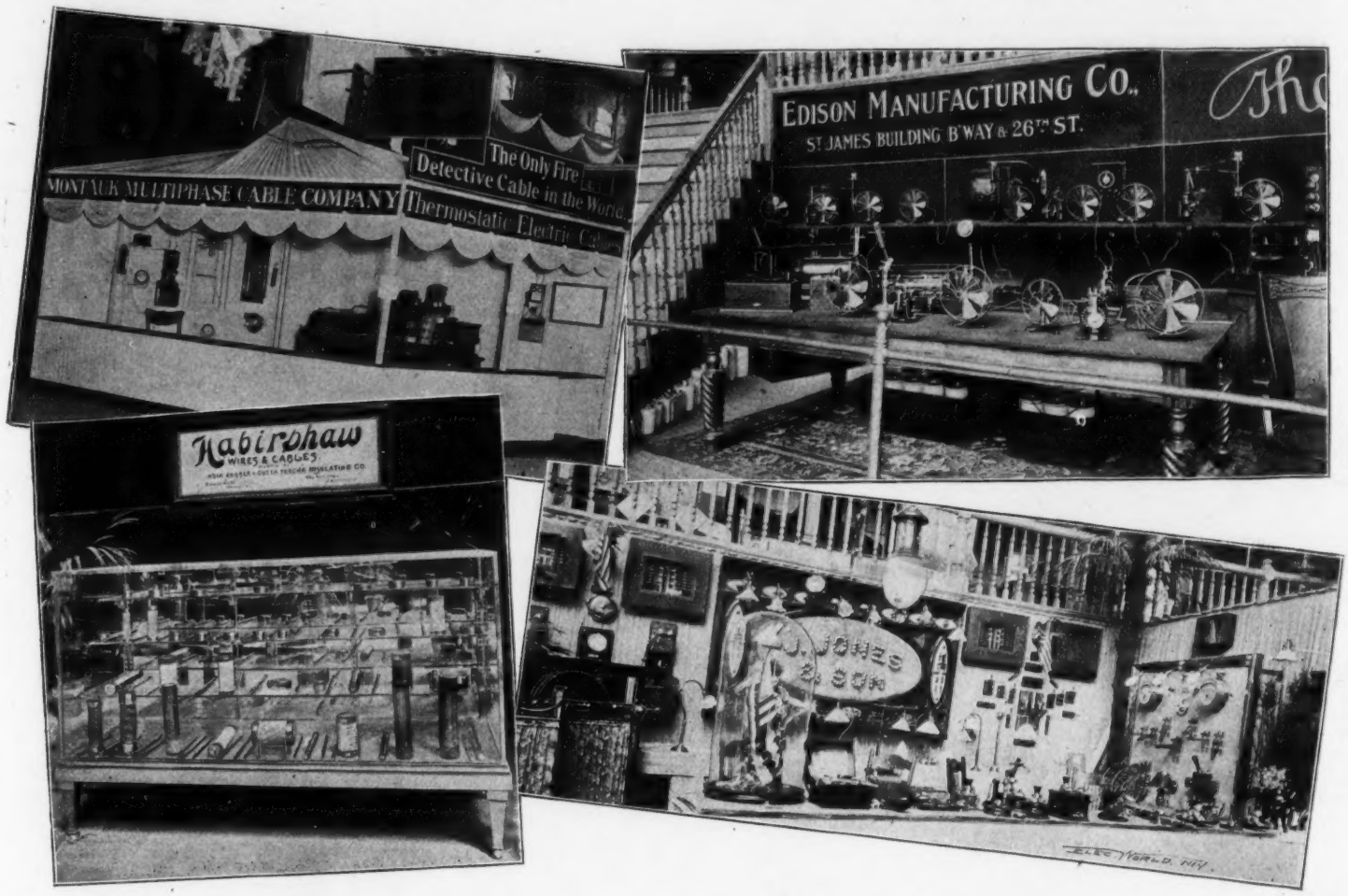
THE ARMORITE INTERIOR CONDUIT COMPANY, 26 Cortlandt Street, New York, shows on a rack at the back of the booth nine samples of 10-foot lengths of Armorite conduit of different diameters, ranging from five-eighths of an inch to 4 inches. Samples of joints of different diameters and angles are also shown.

THE KEUFFEL & ESSER COMPANY, New York, has an exhibit that is attracting the attention of engineers and draughtsmen. It consists of a full line of drawing materials and instruments and of surveying instruments. Slide rules, protractors, etc., which are largely used by electrical engineers in designing, are displayed in a large variety. The exhibit includes drawing and blue printing papers, etc., and is very complete.

MESSRS. J. H. WILLIAMS & CO., Brooklyn, N. Y., have an exhibit of drop forgings, including wrenches, field magnet cores, eye bolts and other parts used in the manufacture of electrical machinery. Some field magnet cores of Crocker-Wheeler motors, set on small gun carriages, look much like actual guns at first glance.

THE GARVIN MACHINE COMPANY, New York, has an exhibit of an automatic tapping machine and wire-feed screw machine. The excellence of finish of these machines is very noticeable. Mr. H. W. Holbrook, who is in charge of the company's interests at the Garden, distributes circulars, etc., describing the company's large line of tools, which are carried in stock at the store, corner Spring and Varick Streets. Although the exhibit is not very extensive the Garvin Machine Company is attracting a large share of attention from those interested in this particular line.

THE TOLEDO LAMP is the latest thing out in enclosed arcs, and is shown in the exhibit of J. Jones & Son, which firm has the rights to manufacture and sell exclusively east of the Mississippi. The lamp is manufactured by the Toledo Lamp Company from the designs of the inventor, Mr. C. E. Irish, Toledo, Ohio, and its peculiarity is that there is no magnet whatever in the controlling mechanisms, the thermal expansion of conductors being depended on to operate the clutch. The mechanism consists simply of three fine flat bands of a special alloy having a large thermal expension coefficient, connected together by whiffletrees so that the expansion of the three is cumulative and finally connected to the clutch by a multiplying lever giving a ratio of about 10 to 1. The straps are each about 14 inches long and have a conductivity equivalent to that of No. 24 copper wire. Their aggregate expansion from atmospheric temperature to the running temperature is about one-eighth of an inch. The clutch works directly on the carbon and gives the lamp what is known as a "sneak" feed. The operation is most beautiful, the arc being struck as quickly as in any magnet lamp and quickly finding itself if disturbed or interfered with in any way. It obviously works on alternating current circuits exactly as on the direct, and can be switched over from one to the other with no change of adjustment. There is also no hum from any magnet or mechanism when working on alternating currents. The new arc lamp is the particular pride of Mr. E. A. Lowe, the manager for J. Jones & Son.


MONTAUK MULTIPHASE CABLE COMPANY
The Only Fire Detective Cable in the World
Thermostatic Electric Co.
Habirshaw
WIRES & CABLES
EDISON MANUFACTURING CO.,
ST. JAMES BUILDING B'WAY & 26TH ST.
J. JONES & SON
ELEC. WORLD. NEW.

MONTAUK MULTIPHASE CABLE COMPANY.
EXHIBIT OF HABIRSHAW WIRES AND CABLES.

THE EDISON MANUFACTURING COMPANY'S EXHIBIT.
J. JONES & SON'S EXHIBIT.

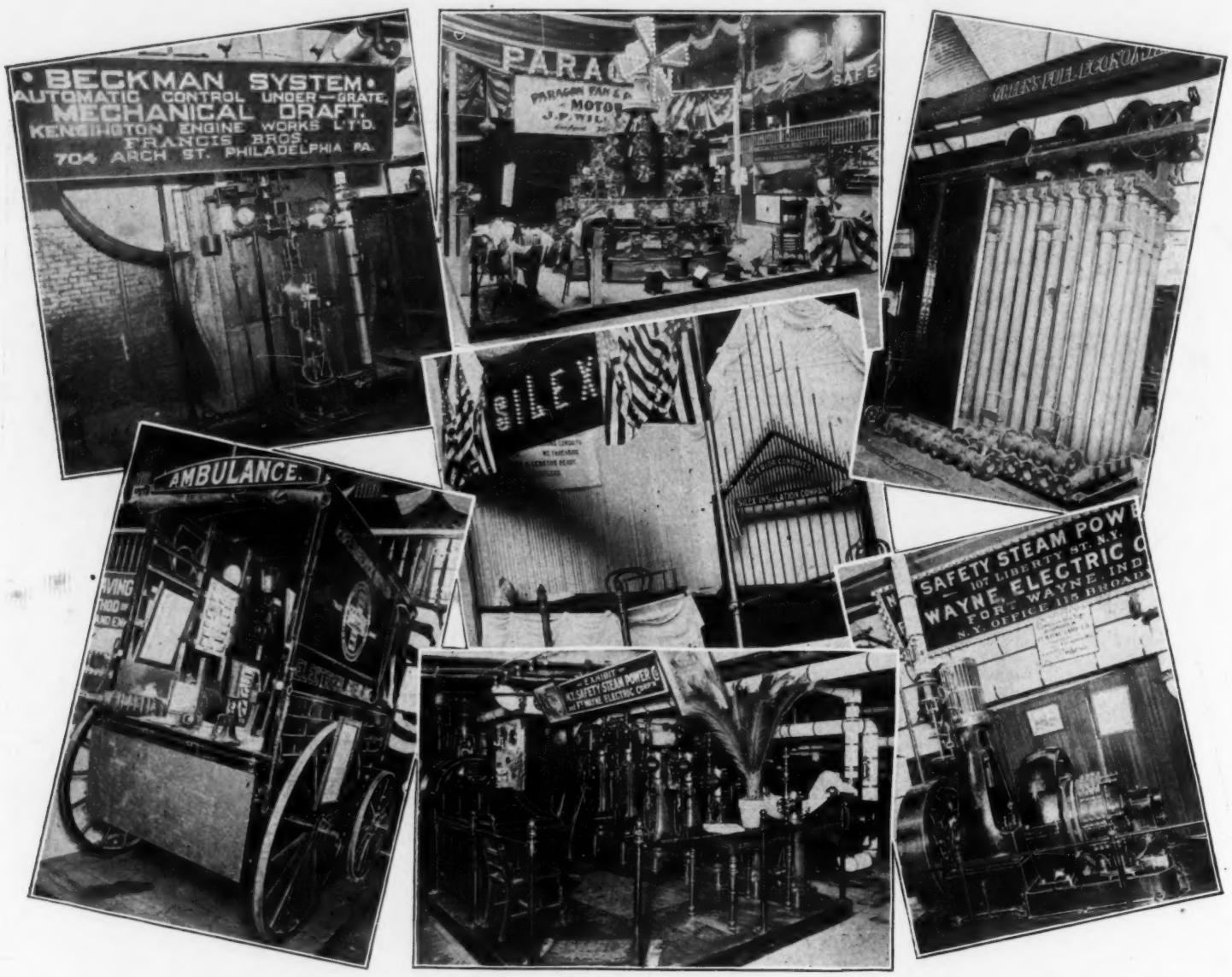
THE BECKMAN SYSTEM of closed ash pit forced draft, as installed by the Kensington Engine Works, Philadelphia, regulates the steam pressure on the boilers mentioned above. This system comprises a blower, in this particular installation 54 inches in diameter, and in a 90-inch casing, direct coupled to an upright 6x6 engine. This maintains an air pressure of from one-half to 1 inch of water at the ash pit. The peculiarity of the system is a mechanical regulating device consisting of three valves, one a pressure reducing valve for determining the maximum speed of the engine; one a controlling valve which opens when the steam pressure falls and closes when the steam pressure rises beyond pre-determined limits; and the third a pressure reducing bypass valve around both the others for maintaining the engine in slow motion, preventing it getting on dead centre and keeping a slight circulation of air under the grates at all times. By means of these valves all the fireman has to do is to keep the fires in good condition, the automatic system maintaining the steam pressure under any variation of load within the capacity of the boilers. The valves were supplied by the Mason Regulator Company, Boston, Mass.

THE SILEX INSULATION COMPANY, 39-41 Cortlandt Street, New York City, exhibits insulated conduits having a heavy protecting metallic shell, a smooth inner metal lining, and between the lining and the shell a packing of particles of a refractory inorganic material, which arches around the inner tube, keeping it exactly in the centre of the outer tube. This material is a flexible mineral insulator, the particles of which are free to move relatively, thus giving the qualities of flexibility, incombustibility, heat and electrical insulation and durability. There s shown at the exhibition the smallest commercial size of conduit used for interior wiring with a red-hot wire running through it without in any way injuring it. If the rubber covered wires which usually run through interior conduits were entirely melted by excessive currents it would not affect the conduit and a new pair of wires could be drawn through. The exhibit shows the interior conduit only, but the company makes an underground conduit for long-distance transmision of the electric current suited for much higher voltages than have heretofore been considered commercial, and consequently for transmission distances which have not been heretofore attempted.

MR. J. P. WILLIAMS, general agent of Paragon fan and power motors, has a very attractive display of these machines in a prominent position on the main floor. The principal feature of the exhibit consists of a conical shaped stand on which are five steps at equal distances apart from the floor up to the apex. On these steps are placed Paragon fan motors of different styles and finishes, all in operation and full of business. The apex of the cone is surmounted by a huge fan motor painted in white, the motor itself, as well as the fan, revolving. The blades of this large fan are outlined with incandescent lamps, which are lighted, and as they turn around they attract considerable attention. A novelty shown by Mr. Williams is a cradle, which is rocked by means of the power of a small electric motor, transmitted to the cradle by means of a crank. A 1-hp motor is connected to and drives a generator of the same size by a cotton belt. Several small motors are also shown, also two ceiling fans. The word "Paragon" in large letters appears at the back of the booth in frosted incandescent lamps.

THE AMERICAN ELECTRICAL & MAINTENANCE COMPANY shows a hospital service for isolated and other small electrical plants. The exhibit consists of an ambulance intended to be run by inspectors of the company for the care and repair of dynamos, motors and other electrical machinery, and replacement of worn or damaged parts, the company undertaking such work at a fixed annual sum. The company has shops at 451 Greenwich Street, New York, within call of which it has such ambulances and gangs of men who can take care of breakdowns and minor troubles on emergency calls. To complete the analogy with relief service for physical disablements the company's distinguishing mark is a white cross, which should become to electrical men a sign of relief in time of trouble.

THE FUEL ECONOMIZER COMPANY, Matteawan, N. Y., shows a Green's fuel economizer or feedwater heater, with the cover removed to show the parts. The machine is rated at 150 horse-power, being built of forty-eight tubes 4 inches in diameter and 9 feet long. The scrapers are shown in motion, driven by a small horizontal engine mounted on top of the economizer. The exhibit shows most clearly the sectional cover adopted by the Fuel Economizer Company to give the ready access to the parts unobtainable in bricked-



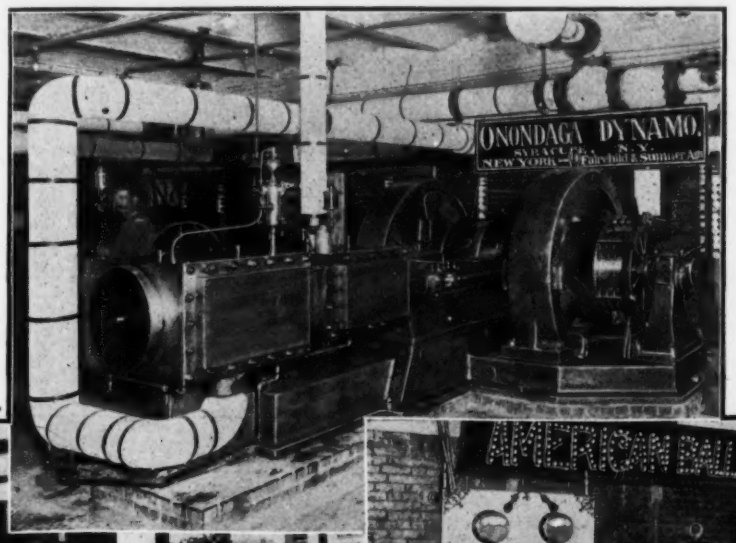
Kensington Engine Works.
American Electrical and Maintenance Company.

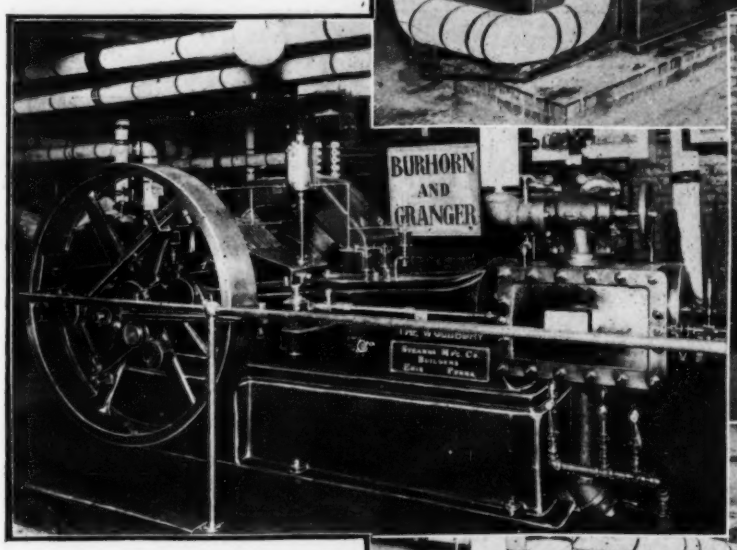
Paragon Fan Motors.
Silex Insulation Exhibit.
New York Safety Steam Power Company.

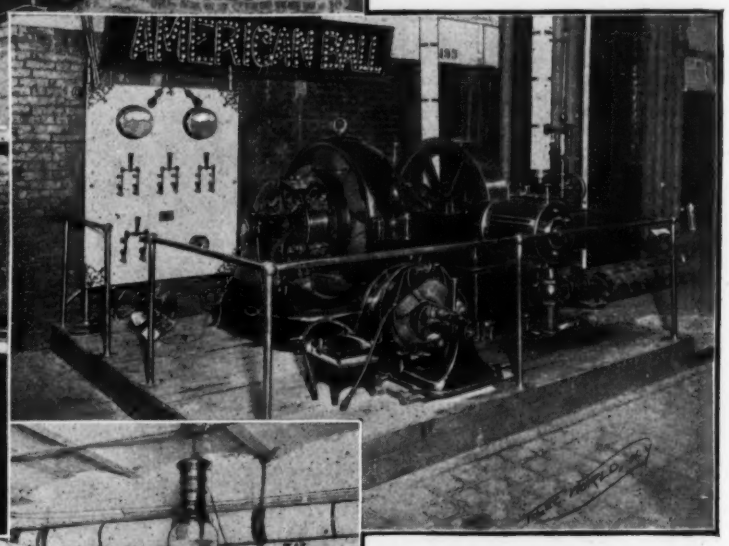
The Fuel Economizer Company.
New York Safety Engine and Wood Dynamo.

in heaters. This consists of an iron-plate shell in sections, with flanged edges, a 2-inch layer of asbestos to give heat insulation, and an inner iron plate bolted through to the outer plate, the asbestos being firmly held between the two. The tubes of the economizer are driven hydraulically into slightly tapered orifices in the headers, the upper ends of the tubes being expanded so that when cut the whole tube can be drawn up through the top header. In a separate header there is shown the arrangement of butterfly valves, with connecting links for changing the circulation of the water in the economizer from natural to forced flow. The latter makes the water rise through one row of pipes and fall through the next throughout the heater.

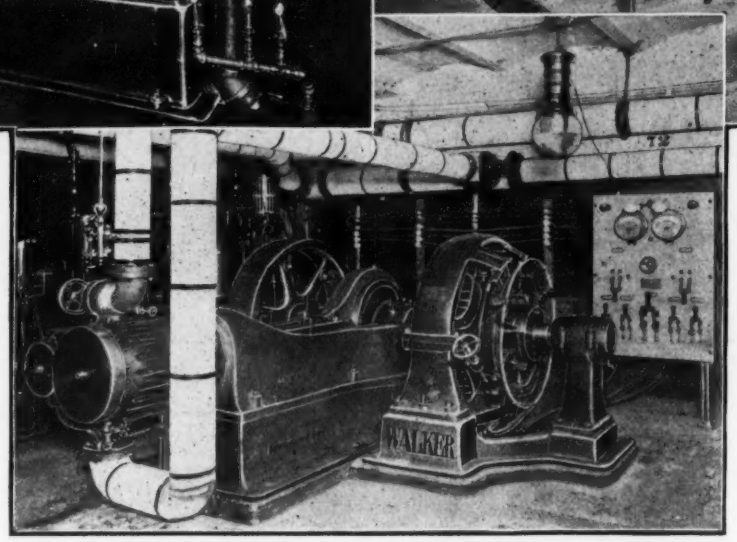
MESSRS. MANNING, MAXWELL & MOORE, 111 and 113 Liberty Street, New York, as representatives of the Ashcroft Manufacturing Company, the Consolidated Safety Valve Company, and the Hayden & Derby Manufacturing Company, have an interesting exhibit of steam specialties. There are shown Ashcroft pressure and vacuum gauges, Edson recording gauges, Ashcroft safety recorders, Tabor indicators for steam and gas engines, the Coffin averaging instrument, and other of the many products of the Ashcroft Manufacturing Company. The Consolidated Safety Valve Company is represented by Richardson-Ashcroft solid nickel-seated pop safety valves and Richardson patent shifting and water relief valves. The Hayden & Derby Manufacturing Company's automatic indicators, H.—D. noiseless water heaters and many other devices manufactured by this company are shown. The Babcock & Wilcox steam boilers in the basement are fitted with Ashcroft steam gauges and Consolidated safety valves.







THE WOODBURY ENGINE AND EDDY DYNAMO.



THE FISCHER ENGINE AND ONONDAGA DYNAMO.
THE ARMINGTON & SIMS ENGINE AND WALKER DYNAMO.

THE ARMINGTON & SIMS COMPANY, Providence, R. I., has on exhibition a 13x12 horizontal engine rated at 90 horse-power at 275 r. p. m., with 90 pounds steam pressure. This engine is fitted with new snap packing rings in the piston valve, and with complete gravity feed oiling system for the crosshead slides and crank pin. It is governed by a Rites governor. Mounted on the single shaft of this generating set is a six-pole, 50-kw, 125-volt Walker generator of standard direct driven construction.

THE NEW YORK SAFETY STEAM POWER COMPANY, New York, makes an extensive exhibit, the principal feature of which is a 125-hp vertical single cylinder engine, direct coupled to a multipolar 125-volt Wood dynamo, supplied by the Fort Wayne Electric Corporation. The cylinder dimensions of this engine are 14 inches diameter by 12-inch stroke, the rated output being 125 horse-power at 275 revolutions. The engine is fitted with a packed piston valve controlled by a Nichols shaft governor, and is shown at the exhibition equipped with the Monarch speed-limit device. The New York Safety Steam Power Company also exhibits a row of ten vertical engines ranging in size from 3 to 15 horse-power.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., shows a complete generating set, both engine and dynamo being made by the same company. The American-Ball engine shown has a single cylinder, 8½x8 inches in size, and delivers 35 horse-power at 375 revolutions. The engine is fitted with a partially balanced flat valve working between two seats in the steam chest, each side being fitted with steam ports. An interesting feature of this engine is the self-oiling arrangement, which is a positive pressure system, consisting of a small pump worked from the valve rock arm forcing oil under heavy pressure to all surfaces that need lubrication. The pump is built into the engine and the oil tank is formed in the main casting of the base, thus making the whole machine self-contained. Mounted on the shaft of this engine is a 25-kw, 125-volt, 6-pole American Ball dynamo, the armature of which is wound with formed coils, with straight out end connections. The brush holders of this generator are new, and comprise two helical springs, with a tightening screw for clamping the brush firmly in the holder and a spiral spring acting through a gear and rack to hold the brush against the commutator. Flexible copper conductors carry the current to the base of the holder. The load on this machine at the exhibition averages 120 amperes.

THE FISCHER FOUNDRY & MACHINE COMPANY shows the only compound engine in the exhibition. This engine is a horizontal single crank tandem compound machine, with the low-pressure cylinder overhung at the far end of the piston rod, thus allowing the removal of both of the pistons without taking down either cylinder. The engine is of the four-valve type, the admission valve being controlled by a modified Rites governor, the main pivot of which is a roller bearing. Another interesting feature of the engine is the oil circulation. The crank case, although enclosed, does not carry oil, but there is an oil chamber about it in which dip two oiling chains running over the main bearings. These lift oil onto the main bearings, which carry it toward the crank disc, through which it is slung by centrifugal force to the crank pin. The crank pin again throws it off, that thrown in the upper half of the case being led back into the oil chamber or into a small compartment from which it is wiped by a projection on the cross head, thus oiling the crosshead pin and slides. The crosshead chamber is enclosed with the crank chamber, and the piston rod is packed so that any steam escaping from the cylinder along the piston rod escapes into the atmosphere and is carried away from the crosshead enclosing chamber, thus avoiding any heating of these parts. The dimensions of the engine shown at the exhibition are 9½ and 15 inches by 12-inch stroke, the machine running at 275 r. p. m. and rated at 125 horsepower.

THE AMERICAN BALL ENGINE AND DYNAMO.

THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., has one of its dynamos mounted on a one-piece shaft with the Fischer engine mentioned above. The machine is six-pole type, rated at 72 kilowatts and wound for 125 volts. The field magnet consists of a gray iron yoke in which forged iron cores are cast. Reaction brush holders with copper braid attachments to the carbon brushes are used. The armature coils are machine formed, with spiral end connections. The machine was installed by Fairchild & Sumner, 39 Cortlandt Street, New York.

THE WOODBURY ENGINE, built by the Stearns Manufacturing Company, Erie, Pa., and installed by the New York agents, Messrs. Burhorn & Granger, 136 Liberty Street, gives by means of a tachometer and an ammeter a most instructive exhibit of the perfection of the modern governor, particularly of the Shepherd governor used on this engine. With four-fifths of the rated load of the direct coupled generator thrown on and off the tachometer indicates a variation in speed of about two revolutions, this being less than 1 per cent, of the speed of the engine, 290 r. p. m. The Shepherd governor is of the balanced type, the moving parts being fulcrumed on a single roller bearing, the spring being attached by a knife edge bearing. Coupled to the shaft of this engine by a flange coupling is a multipolar Eddy dynamo of 25 kilowatts.

The K. & W. Co.'s Exhibit.

THE EXCELSIOR ELECTRIC COMPANY, New York, makes a most complete exhibit, consisting largely of machines embodying the novel and ingenious designs of alternating machinery of Mr. A. Churchward. The largest machine in the exhibit is a 75-kw, 8-pole direct current generator, designed to be direct driven at 275 revolutions. The field cores of this machine are solid and are cast integrally with the yoke. This generator is fitted with brushes of Mr. Churchward's design, now universally used on Excelsior constant potential machines, the peculiarity of the holder being the fact that the carbon brush is bound tightly in a copper strap, to which a heavy copper braid is riveted for conductivity, the holder sliding radially in a frame and forced down by a helical spring, which is insulated so that the current cannot enter it and overheat it. The rocker ring is supported by lugs on the magnet yoke. Another peculiarity of this machine is the fact that the series coils of the compound field winding are connected up in multiple with each other between heavy conducting rings concentric with the shaft, one on each side of the poles. The armature laminæ are separated by sheets of paper, and the armature winding is of the straight out or barrel type. The armature of the 75-kw generator is shown removed from the fields with a 15-kw armature beside it and a one kilowatt on top of it, showing the armature construction of different sizes. Adjacent to this are a 2-hp multipolar machine running at 1500 revolutions, a 22½-kw machine running at 750 revolutions and a single armature, three-wire continuous current transformer for balancing the voltages across a three-wire system. The transforming capacity of this machine is five kilowatts. A 3-hp ironclad machine, especially designed for ammunition hoists, is shown, and beside it is a machine which looks as though it were affected by the hot weather and were just about to stop. This is a 10-hp motor running at 150 revolutions, the peripheral speed being but 750 feet per minute, the total weight of the machine in spite of this low speed being only 1400 pounds. It is shown belted to and driving a 2000-cp 100-light Excelsior arc machine carrying several arc lights, the load of the motor being about 15 horse-power. Some small motors for running on arc lighting circuits with automatic speed regulating devices are also on exhibit, as is a complete switchboard fitted with apparatus for alternating current, direct current and series work. A number of Leonard circuit breakers are mounted on this board. The most interesting machines in the exhibit are

The Excelsior Electric Company, Churchward Apparatus.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., occupies an enclosure on the main floor, which is roofed over with the company's patent anti-condensation corrugated iron roof covering. This roofing is recommended by the company for electric light and power stations. It is stated to be absolutely fireproof, and will not condense moisture on the under side no matter what are the changes of temperature. A sample of the company's patent roof lining is shown.

THE K. & W. COMPANY, Pittsfield, Mass, attracts attention to its exhibit on the main floor by means of its sign, on which the word "Hardy" is spelled in small Hardy red incandescent lamps. In a show case at the front of the booth are displayed Hardy lamps of all voltages, bases and styles, including bung-hole lamps, decorative and plain lamps. Mr. Charles Houliston, the company's New York representative who has charge of the exhibit, distributes a chart showing the average candles and average watts per candle of the first month's production of Hardy incandescent lamps. Eight lamps were tested and the curve shows that the average watts per candle at the start were three and one-half; at the end of 1000 hours they had risen to six and three-fourths. The average candle power at the start was sixteen, it rose to eighteen at the end of fifty hours, and maintained that average until nearly 300 hours, when it began to gradually decline. At the end of 1000 hours the average candle power had decreased to ten. Another show case contains samples of the K. & W. arc lamp cut-outs, commutator lubricating compound and a line of dynamo brushes. The K. & W. spark arresters are also shown. These arresters, beside being spark proof, are weatherproof.

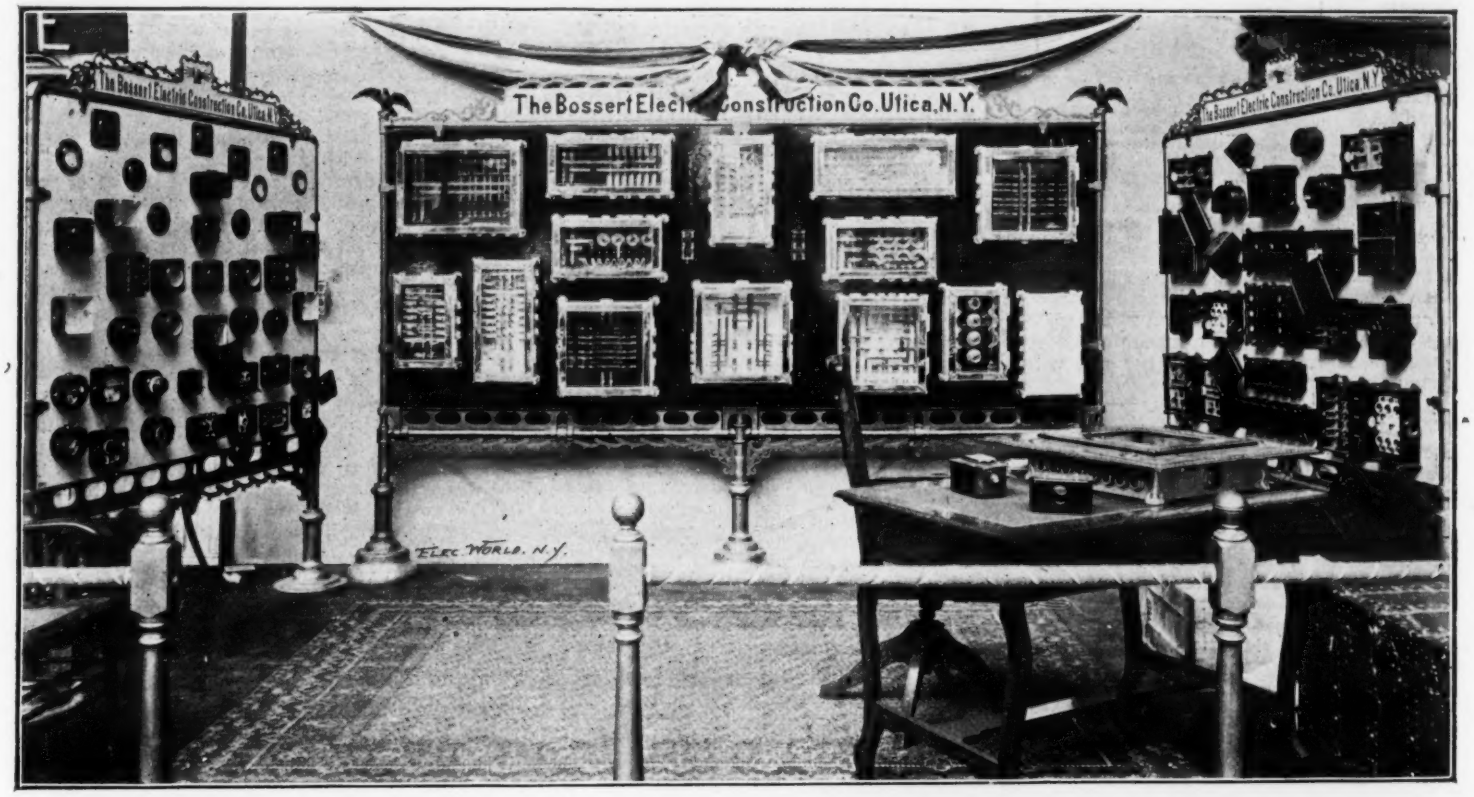
the synchronous motors and rotary transformers of Mr. Churchward's design. Several of these of various sizes are shown, all constructed on the same general principle. Briefly, the design consists of an ordinary multipolar compound wound field enclosing an armature fitted with a commutator on one end and collector rings and a rectifier on the other. In starting, the shunt fields are open circuited, and the series field coils are connected in series with the commutator and across the alternating current mains, giving a simple series motor with A. C. supply. This brings the machine up with a good torque to synchronism, which is indicated by a lamp on the top of the machine. On throwing the main controller from the starting to the running position the A. C. supply is thrown into the collector rings, the series fields are connected across the rectifier brushes and the shunt fields are connected across the commutator, making the machine a self-exciting synchronous motor or rotary. The controller is so fitted as to break the shunt field coils into a large number of small independent circuits, thus dividing up the high potential which would be generated in them by the transformer effect of the A. C. currents in the series field windings in starting. In throwing over to the running position these sections are connected in series and across the commutator. The controller is also fitted with a trigger and low voltage release magnet connected in series with the shunt field, this being also controlled by an overload relay connected in the A. C. supply circuit. The handle is also fitted with a spring and catch, so arranged that it cannot be left in the starting position wherein the motor would tend to run away when light loaded, and cannot be left in the running position if thrown into that position before the motor reaches synchronism, and there-

fore fails to operate. The compound winding of the machine is so adjusted as to give a high power factor or even leading currents, if desired, at any and all loads, and this is the case whether the loads are mechanical ones applied to the shaft, electrical ones due to direct current drawn from the commutator, or a combination of the two, as the series coils are supplied by a rectifier from the A. C. side. The controlling device also provides for any emergency. Of these machines the largest in a 30-kw, single-phase 16,000 alternation machine transforming from the direct current supplied to the exhibit to 133 cycle single-phase alternating current, and also driving by means of a belt an A. C. generator giving sixty-cycle currents. A rotary for 133 cycles is a rarity at the present date, and the running of this machine is watched with no little interest. The machine is necessarily pretty well crowded, being fitted with twelve poles, and even then requiring a peripheral speed of 5800 feet per minute, which presents a great contrast in this respect with the machine mentioned above, having a peripheral speed of 750 feet per minute. In spite of this crowding and rapid reversal the commutation appears to be perfect. To exhibit practically to alternating current central station men the advantage of these machines several of them are shown in operation as loaded motors, and others are shown supplying direct current machines. One 1-hp A. C. motor is shown driving a 36-inch Blackman exhaust fan. This machine is arranged for automatic control to illustrate how such machines may be operated by a float in a tank or any such automatic device or by push buttons at a distance. The throwing of the controller from the starting to the running position is effected by a centrifugal governor device on the main shaft, so adjusted as to throw over at synchronous speed. A 5-kw synchronous motor for 7200 alternations is shown, as is a rotary for college and laboratory use, this machine being fitted with collector rings so that any commercial number of phases can be applied and any other commercial number can be taken off, or direct or monophase current supplied or withdrawn. The Otis house elevator electric engine is also shown in operation taking current from a rotary, and a standard air brake pumping equipment, driven by a 1½-hp motor, supplies air to a tank and whistle which is operated by an automatic apparatus supplied by the Signal & Control Company.

THE AMERICAN ELECTRIC NOVELTY MANUFACTURING COMPANY, 231 Broadway, New York, shows a line of fancy articles in which electricity is applied in some form or another. There is a line of jardinieres with tiny electric lamps scattered through the leaves. These attract the attention of the lady visitors. A line of night lamps of various designs is shown. Among these there is a candlestick lighted by a 2-cp lamp, the lamp being supplied with current from small dry batteries placed in the base of the candlestick. There is also a line of bicycle lamps, which are recommended to be very satisfactory in practical use. A portable searchlight consists of a tube about 1 foot long and 1½ inches in diameter. The tube contains five cells of dry battery at one end and at the other a small electric lamp, reflector and lens are set. This lamp, by pressing a little button, throws out quite a strong light. It is a very useful device for an occasional light around the house at night. There is shown a line of attractively designed cigar lighters.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., has an attractive exhibit on the main floor. At the back of the booth are displayed thirteen panel boxes for two and three wire systems. These boxes are handsomely finished both inside and out, and are provided with bevel plate-glass fronts. Some of the panel boxes are fitted with porcelain fuse blocks, which are readily removable and replaceable. On the exhibit board at the right is shown a line of iron outlet boxes, junction boxes, main and branch fuse blocks enclosed in iron cases, iron main elbows, etc., and on the board at the left-hand side is a line of samples of steel outlet, cut-out and switch boxes. These boxes are indestructible, and, in connection with iron armored conduit, make an ideal fireproof construction. The steel junction and distribution box is constructed of wrought steel lined with slate, and is designed for any number of arrangements of circuits, with or without switches, for either two or three wire systems. The steel-drawn outlet and switch boxes, feeder, branch circuit and cut-out boxes are drawn from one piece of sheet steel under heavy pressure, and are water tight, fire and nail proof. They are manufactured with either plain holes for conduit or with drawn and threaded lugs, into which the conduit may be screwed. The holes are hermetically sealed with a steel plug, which can be removed with a sharp blow of a hammer. These boxes are adapted to any arrangement of conduit. On a table in the booth are samples of boxes showing the different styles of finish, including agate, blue and black enamel. The different stages of the manufacture of the boxes is also exemplified by samples.

MR. H. B. KIRKLAND, 120 Liberty Street, New York, occupies a prominent position on the main floor with quite an extensive exhibit of the manufactures of the different companies represented by him. In a sample showcase are shown a line of telephone carbon specialties, carbon brushes, etc., manufactured by the Solar Carbon & Manufacturing Company, Pittsburg, Pa. On a frame is exhibited a full line of quick-break switches, both single and double pole, and arc light cut-outs manufactured by the Hope Electric Appliance Company, Providence, R. I. On the floor of the booth is seen an immense break switch of 2000 amperes manufactured by the same company. In addition to these exhibits there is a line of C-S flush switches, Wirt rheostats and rolls of American Circular Loom tubing of different diameters.



THE BOSSERT ELECTRIC CONSTRUCTION COMPANY.

H. B. KIRKLAND'S EXHIBIT.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

CARBON BRUSH HOLDERS. Scott. Lond. "Elec. Rev.," May 6.—The conclusion of his illustrated article (see "Digest," May 14). He gives illustrated descriptions of a number of brush holders, some of which are American types. The following table is given, in which the amperes per square inch of contact for carbon brushes

Amperes.	Metal Gauze Brushes.		Carbon Brushes.	
	Number.	Size.	Number.	Size.
20	1	7 × 2 × 1/4	1	3 1/2 × 2 × 1/2
45	2	7 × 2 × 1/4	2	3 1/2 × 2 × 1/2
75	2	7 × 2 × 1/4	3	3 1/2 × 2 × 1/2
115	3	7 × 2 × 1/4	3	3 1/2 × 2 × 1/2
165	3	7 × 2 × 1/4	4	5 × 2 × 3/4
225	4	7 × 2 × 1/4	4	5 × 2 × 3/4
300	4	7 × 2 × 1/4	5	5 × 2 × 3/4
450	5	7 × 2 × 1/4	5	7 × 2 × 1
600	6	7 × 2 × 1/4	6	7 × 2 × 1

is assumed to be about one-quarter of that allowed for metal gauze brushes. Another table gives the sizes of the brush flexibles, and is based on a current density of 2000 amperes per square inch. Another gives the width of commutators corresponding to different numbers of brushes.

STARTING SINGLE-PHASE NON-SYNCHRONOUS MOTORS. Arno. "Elek. Zeit.," May 5.—A reply to recent unfavorable criticisms of the novelty of his system; he endeavors to show that the idea was not known before, and states that the fact that a number of companies are about to adopt his system shows that it has value. Among other things he states that Steinmetz, in a recent American Institute paper, read February 23, remarked that the starting device is to bring the motor up to a considerable speed; this is quite the contrary to what is the case with the application of Arno's system.

ARMATURE REACTION. Bessey. "Elec. Eng.," May 12.—Some curves which he obtained in order to show the influence of the armature on the field in shunt and compound machines. Three sets of curves were taken, one for the induction distribution with the field excited and no current in the armature; the second with the field excited and a current in the armature; and the third with a current in the armature and no field magnetism. The induction was measured with a volt meter between two steel wire brushes, bearing on the commutator at various positions; one of the curves is, as it should be, the algebraic sum of the other two. The effect of the lead is clearly seen, as also the change produced by compounding.

COMMUTATION IN DYNAMOS AND MOTORS. Everett. "West. Elec.," May 14.—A reprint of the article noticed in the "Digest," May 14.

Lights and Lighting.

LIGHTHOUSE. Preller. Lond. "Engineering," May 6.—The beginning of a well illustrated description of the new electric lighthouse of Penmarch-Eckmuhl, on the Bay of Biscay, in France, which was opened for service in October of last year; a double page insert accompanies the description.

LARGE SEARCHLIGHT.—"Eng. News," May 19.—A note stating that the large searchlight which was at the World's Fair has now been placed at the entrance to San Francisco Bay, and is one of the largest in existence. The parabolic glass reflector is 5 feet in diameter, and weighs 800 pounds; the lamp weighs 400; the carbons are 1.5 inches in diameter, and require 200 amperes, the intensity of the naked light being 90,000 to 100,000 candle power, which is concentrated by the reflector to about 375,000,000 candle power "to a distance of between 20 and 30 miles."

CONICAL AND SPHERICAL SHADES. I. C. Thompson. "Elec. Eng.," May 12.—Results of some tests made for comparing conical with spherical shades for incandescent lamps. The results are given in curves, which show that beyond a horizontal distance of 2 feet the curves follow about the same law; the spherical shades give higher results than the naked bulb, which he claims is due to the fact that less light goes to the ceiling. The results favor the spherical shade. A table is given containing the percentages of light reflected from various surfaces in the decorations of a room, the authority in each case being stated. It shows the importance in the selection of the proper paper for walls and ceilings. Another compiled table gives the losses in the various kinds of shades; the effect of the holophane globes is brilliant, but not soft. The following figures from Richards are given for the quantity of light in foot candles which is necessary for various purposes; general house lighting, walls, etc., 0.4; living room, 0.5; bed room, library, study, 0.25; table lighting, 2.0; this does not include reading, sewing, etc.; for workshops, general illumination, 0.2; benches, 3.3; optical or fine work, 5.0; for public halls, 0.33; churches, 0.25; pews and pulpit, 2 to 3.5; street lighting, 0.10 to 0.12.

Power.

UTILIZATION OF BLAST FURNACE GASES. Booth. Lond. "Elec. Rev.," May 6.—The conclusion of his article (see "Digest," May 14). The amount of power that may be regularly and continuously obtained from the waste gas of a blast furnace is 10 horse-power per ton of coal per week; there is therefore a possible saving of enormous extent; his tests on an actual plant more than confirm the figures, and it is beyond doubt that the system is a success commercially as well as mechanically; several such plants are either at work or projected, and one near Lancashire is of special interest, as a length of 1.5 miles of canal is to be used to make a trial of electric traction applied to barges; a gas engine of 30 horse-power will be used for lighting the iron works, for purifying the blast furnace gas by electrification, the gas being passed through a highly charged field, which frees it of the dust; and thirdly, for canal barge traction by means of motors running on a lattice frame rail along the towpath. If about 10,000,000 tons of fuel are used annually in English and Scotch blast furnaces, then about 2,000,000 horse-power is running to waste; the utilization does not involve a great capital expenditure, as is the case with water power; no other system of transmission need be considered; the only cost is that of gas engines, holders, scrubbers and pipes; the whole of the cotton mills in that country would not absorb a fourth of the supply; the production of gas is continuous, and for intermittent work a storage system would be necessary, but as so much power is going to waste it will be some time before storage will be necessary. The heating power of these gases is very poor, and the flame is not suitable for boiler heating, but they are very suitable for gas power purposes, and therefore gas engines and not steam engines should be used for applying them.

BLAST FURNACE GASES.—Lond. "Elec. Eng.," May 6.—An editorial referring to a recent paper by Thwaites before the British Iron Trade Association, on the pioneer plant which was started in 1895, and in which a steam engine was replaced by a gas engine driven by these waste gases; a great saving of space is obtained; one cubic foot of the average blast furnace gas will raise 22,372 pounds one foot high, the gases having a higher thermo-dynamic value than city or retort gas.

APPLICATION OF STEAM TURBINES. Bailie. Lond. "Elec. Rev.," May 6.—A long abstract of a recent paper in which some references are made to the steam turbo-dynamo.

ELECTRICALLY DRIVEN MACHINERY. Wheeler. "El'ty," May 18.—An abstract of his recent paper befor the N. Y. Elec. Soc., in which he calls attention to the advantages and progress of electric driving of shops and factories.

GARBAGE DESTRUCTOR. Ridley. "El'ty," May 11.—Brief descriptions, with some illustrations, of three plants in England.

Traction.

EARTH RETURNS FOR ELECTRIC RAILWAYS. Parshall. Lond. "Elec. Eng.," May 6.—The conclusion of the reprint of his paper, with the discussion (see "Digest," last week). He referred to a recent plant which he designed for 250 cars and in which several earth generators will be used, feeding from several points of the system; pairs of test wires are run back to the station from various points, one being connected to the track return and the other to the adjacent earth plates; the earth return will in general be kept positive to the neighboring water or other pipes, as whatever electrolysis there is will then be on the track. An analysis of some English and American steel rails are given, with a table giving the resistances for each of various percentages of impurities; the resistance compared with copper at 20° C. averages slightly above 11, and the resistance of one mile of 1 square inch section at 20° C. varies in the neighborhood of 0.490 to 0.5; the data were obtained from tests of samples. Another table gives the test of eight track rails of 76 pounds, tested in place after 2.5 years use, the average of the two figures above referred to being 10.4 and 0.45; for old or much worn 65-pound rails tested in place the average was 12 and 0.52; for some 90-pound new rails tested in place the average was 10.5 and 4.55. In discussing the question of bonds he states that the fish plates contribute considerably to the conductivity of the joint, and gives some information regarding tests of the resistance of bonds, including the resistance of the contacts and that due to the current "gathering;" A table of the results of tests of various bonds gives the resistance of the bond and that of 176 joints, which means that per mile with 30-foot rails; these cannot be averaged, but he concludes that in general bonds which are properly applied, in clean, bright

reamed holes and with a drift driven square, have practically negligible contact resistance; with at least 100 amperes per square inch the drop in the contact surface was inappreciable compared with that in the bond and in the rail; the same was found true with bonds that have been in use for over two years with that limited current density; the experiments were very extended; it has been claimed that the contact resistance is greatly lessend by amalgamation, but he concludes that this will not be the case unless the bond is put in carelessly. Tests on an 83-pound rail showed a "gathering" resistance equivalent to 3.4 inches of rail at each contact or a total of 6.8 inches per joint. The question of joints is then discussed, and the results of a number of tests are given, showing the additional resistance due to the joint, in ohms, in inches of rail or in ohms per mile, for each of a number of bonds. From this he concludes that it is safe to take the resistance through fish plates as equivalent to about 50 inches of rail and to use this resistance as in parallel with the bond; on this basis he constructs curves for various systems of bonding, showing the various elements of the total resistance. The apparatus used for testing is briefly referred to; the voltage was measured between two points on the rails when a constant current of 30 to 150 amperes was flowing and a standard resistance of 0.0000398 was placed in the same circuit, the voltage at the terminals of this being compared with that across the bonds on the rails. When the measurements are made on the actual track the current was supplied by a portable accumulator, the voltage being measured between the two points inside of those at which the current was led into the rail and two points on the same rail outside, the standard resistance being also included; the resistance is then calculated, provided there were no cross bonds on the track under test; it was found very important to reverse the current, on account of the thermo-electric effects; the current in the rails at intermediate points could be measured by taking the voltage between two points on the same metals which had been tested for resistance as above described; the volts required for driving the current through the whole length of track were measured by test wires.

A reprint of the complete paper is begun in the Lond. "Elec. Rev.," and the discussion is abstracted briefly. The whole paper and discussion are published in the Lond. "Elec.," May 6; the discussion appears to contain nothing of importance; Ayrton advocated using an insulated feed and return; Parshall, referring to the disturbances in magnetic observatories, remarked that it was a question of the survival of the fittest and that the fittest would probably be the electric railway.

ELECTRIC TRACTION IN BERLIN.—"Elek. Zeit.," May 5.—A short, illustrated article giving some information regarding the introduction of electric traction on one of the lines. Some of the cars will be run by the mixed accumulator and trolley system, while others will be used only with the trolley system; the 200 cells which are under the seats are charged on the car; the cars are braked regularly by shore circuiting the motors through a gradually decreasing resistance; when the accumulators alone are used the circuits are disconnected from the ground.

BRUSSELS.—"L'Energie Elec.," May 1.—A long, well illustrated description, with a number of details, of the lines in Brussels, including the underground conduit line, in which the conduit is under the rails.

UNDERGROUND TRACTION IN PARIS.—"L'Eclairage Elec.," April 30.—Some further notes regarding the system of lines which it has been decided to construct.

CONTROLLERS. Blondel. "L'Eclairage Elec.," April 30.—A French translation in full of the German articles noticed in the "Digest," November 20.

SURFACE CONTACT SYSTEMS. Pellissier. "L'Eclairage Elec.," April 30.—Illustrated descriptions of several systems taken from patent specifications.

SUBMARINE BOAT. Lloyd. "Elec. Eng.," May 12.—An illustration, with some brief remarks about the Holland boat. The weight is about 75 tons, of which 22.5 is storage batteries; these, when discharging at 350 amperes for four hours, develop a speed of 8 knots; it carries enough fuel for 1000 miles, and the storage battery capacity is sufficient for one day's operation. The rest of the data has already been given in the "Digest."

MOTOR FOR CARRIAGES.—"West. Elec.," May 14.—An illustrated description of the Morrison system. A small gasoline engine of 4 horse-power revolves the field magnets of what is termed a combined generator and motor, the armature of which revolves freely on the shaft, but is geared with the wheels; the engine, and therefore the field, has a constant speed, no matter what the speed of the vehicle; the armature has a tendency to revolve with the field, but is held back by the load which it is to drive; thus the power of the engine is communicated to the wheels through this electrical device, which acts somewhat similarly to a variable speed clutch. The whole outfit is said to weigh 200 pounds, the engine having a capacity of 4 horse-power. (Nothing is said about the energy wasted in the electrical circuit.)

METROPOLITAN COMPANY OF NEW YORK.—"Elec. Eng.," May 12.—A brief illustrated description of some of the features of the electrical construction and station equipment of the Metropolitan Street Railway Company's plant, including the names of the manufacturers of all the goods.

CHICAGO.—"St. Ry. Rev.," May 14.—A brief illustrated description of the power station of the South Side Elevated Railroad.

LOCOMOTIVE.—"St. Ry. Rev.," May 15.—A reprint of the illustration and brief description of the small narrow gauge locomotive in Austria, referred to in the "Digest," March 5.

PROTECTING TROLLEY AND FEEDER LINES.—"St. Ry. Rev.," May 15.—A few suggested methods of protection.

ELECTRIC RAILWAYS IN THE UNITED KINGDOM.—"St. Ry. Rev.," May 15.—Some notes of a general character, with special reference to municipal ownership as compared with companies.

MUNICIPAL OWNERSHIP IN GLASGOW.—"St. Ry. Rev.," May 15.—A long extract from a recent paper by Porter on municipal ownership and operation of street railways in England; it is mostly on Glasgow (which is in Scotland, and not in England.)

EARLY ELECTRIC RAILROADS. Henry. "Elec. Eng.," May 12.—Illustrations of some views heretofore unpublished, showing some of the efforts of that writer in this field during the years 1884 to 1887; that is, prior to the Richmond road. (This subject was covered in THE ELECTRICAL WORLD of April 30.)

Installations, Systems and Appliances.

CENTRAL STATIONS IN SPAIN. Lietke. "Elek. Zeit.," May 5.—An article of a general character on electrical installations in that country. A true electrical industry does not exist there, as all installations are made by foreigners, chiefly Germans. In the middle of last year there were more than 300 central stations, which in number of stations is about equal to Germany, although the population is about as 1 to 3, showing that the electric light is used more in Spain than in Germany. Ninety per cent. of the stations are in small cities and villages; there are none out of forty-eight provinces in which there is not a village having more than 4000 inhabitants which has not its central station. About 60 per cent. of the stations are driven by water power; concessions are very easily obtained, but they are not exclusive, and there is therefore much competition; data concerning the operation is not easily obtained; the total capacity is about 30,000 kilowatts, which is about one-half that in Germany, and the consumption of light per inhabitant is therefore greater in Spain than in Germany; about 35,000 horsepower is generated by steam and 13,000 by water power; gas engines are little used; the smaller stations average only about 70 horsepower; the direct current is used in 40 per cent. of the number of stations, or for 70 per cent. of the total power; accumulators are used in only about 5 per cent. of the stations; most of the stations supply current only from sunset until a little after midnight; 95 per cent. of the wiring is overhead, the wires being secured to the fronts or roofs of houses; street lighting is said to be more extended than in any other country; the warm, dry climate favors insulation; generally there are no reserve machines. The charge per 10 candle power per month is $0.60, where water is used and $0.80 for steam stations. The cost and income of a 70-hp steam station is given. Sometimes byproduct in the manufacture of olive oil is used as a fuel. The selling price is in general about 20 cents per kw hour. There are comparatively few private installations. Applications of the electrical current for other purposes than lighting are comparatively rare, owing to the fact that there are comparatively few industrial establishments; electric railways have only recently made some progress, and there are now two in operation; the maximum speed on the steam railways is 24 miles per hour, and the financial returns are decreasing yearly. The telegraph belongs to the Government; bad construction and maintenance make interruptions a regular occurrence; none of the telegraph wires are underground. There are only 15,000 telephone subscribers; concessions for municipal telephone stations are granted only for twenty years, after which the plant becomes the property of the Government without recompense

CENTRAL STATION STATISTICS FOR GERMANY. Laffargue. "Rev. Gen. des Sc.," April 30.—In a brief abstract of his paper, which was referred to in the "Digest," last week, the following statistics are given: The number of stations (date not given) is 265, the total power 67,900 kilowatts, 204 use the continuous current, 26 the alternating, 16 the polyphase and 14 the polyphase and continuous currents. On September 1, 1897, there were in Germany fifty-six cities in which the total length of electric railways was 957 kilometres, the total power for which was 21,465 kilowatts. At Frankfort (alternating current station) the cost per kw hour was 6.10 cents, including interest and amortization; at Cologne and Duesseldorf this was 3.84 and 2.52 cents respectively, but not including interest and amortization; it takes about 6.6 pounds of coal to produce a kw hour, and the cost of coal is from $2.40 to $3.60 per ton; the selling price varies from 16 to 20 cents per kw hour for lighting and from 5 to 6 cents for motive power, with rebates up to 50 per cent.

STATISTICS OF ENGLISH LIGHTING PLANTS.—Lond. "Elec. Eng.," May 6.—Further unfavorable criticisms of the series of articles by D'Oyly, noticed in the "Digest," April 23. It is stated that some one must have been imposing on that writer while he was visiting that country.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," May 6.—An analysis of the accounts of the Brighton and the Hove stations and of the Leeds railway.

PHASE SPLITTING DEVICE.—"Elek. Rundschau," No. 15; abstracted in "Science Abstracts," April.—A description of a method recently patented by Siemens and Halske for producing a current from a single-phase circuit, which can be made to have any desired phase relation to the original current. It consists in connecting the two opposite corners of a Wheatstone bridge to the mains of the

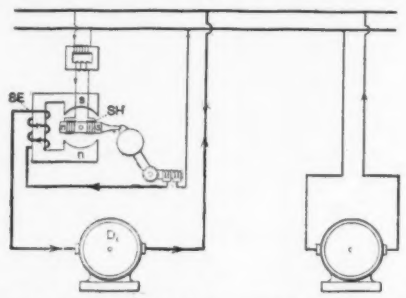
single-phase circuit, the required current being taken off between the other two corners; one pair of the opposite arms of the bridge consists of inductance coils and the other of non-inductive resistances; the resistances and coils therefore alternate in passing around the rectangle; by suitably adjusting the values of the resistances and inductances the phase relation may be made anything desired. Two examples of the practical application are given; one is in the construction of wattmeters whose moving part, consisting of a copper cylinder surrounded by an iron core, forms the armature of a Ferraris motor, the rotating field being produced by two sets of coils, one in the main circuit and the other in the circuit whose phase has been shifted; if the phase shifting is exactly 90° the couple will be proportional to the power. If this couple is balanced by a string the instrument becomes a watt meter. The second application is to the starting of single-phase induction motors which are provided with a supplementary winding connected at starting to that auxiliary circuit; an exceptionally powerful starting torque, it is said, may thus be obtained.

PARIS.—"Sc. Am. Sup.," May 21.—A brief illustrated description from "La Nature" of the large new station at Quai Jemmapes, which was recently referred to in the "Digest," April 23 and May 7.

MUNICIPAL ELECTRIC LIGHTING. Foster. "Elec. Eng.," May 12.—A reply to the recent article by Commons.

Wires, Wiring and Conduits.

PREVENTING INTERRUPTIONS IN SUPPLY. Andrews. Lond. "Elec.," May 6.—A reprint of an Institution paper on the prevention of interruptions to the supply from a station; the paper is well illustrated. He calls attention to the interruptions which are so irritating to consumers, due to circuits being opened; there are often from fifteen to twenty fuses between the generators and the lamps; fuses cannot be relied upon to blow at approximately the current they are set for; similar fuses not infrequently differ by 100 per cent. in their fusing currents. As many fuses as possible should be omitted; the fuses between an alternator and the bus bars cannot protect the machines from being overloaded, because such machines could be short circuited without danger; when two or three machines are working together the fuses of the healthy generator would blow and not those of the faulty one. He then describes what he calls a "discriminating" cut-out which was devised after many trials and is in use at the Hastings station; it is said that it appears to be perfect; the difficulty was increased for alternating currents, as the reversing of the current cannot in these be made use of, but when the direction of the current through a particular machine is considered relatively to that of the current in the mains the problem is simplified. The accompanying diagram shows the principle; it is virtually a shunt wound motor, the magnets being excited by



the alternator which it is intended to control, while the shunt winding (around the armature) is connected across the bus bars through a transformer; the relative direction of the two currents will depend on whether the alternator is generating current or is being driven as a motor; the full arrowheads show the directions when the alternator is a generator, while the dotted ones show the direction when it is acting as a motor; in the latter case the switch will be unlocked, while in the former it will be securely held. The details, which are illustrated, are so arranged that the weight is released without first having to be lifted; no amount of vibration will release it, whereas the pressure of a feather on the armature will do so. The same general arrangement without any winding on the armature makes a very sensitive and reliable excess current cut-out. A cut-out for high tension currents is shown, as also a diagram of the switch gear at that station, where a saving in coal, etc., of $2000 has been effected during the past eighteen months, owing to the fact that the running of a spare plant was rendered unnecessary; the arrangement is based on the use of spare bus bars. An excess current cut-out should certainly be used on the feeders, and the magnetic kind is preferred: they can also be used as switches. He then calls attention to the importance of the duplication of the mains; this problem has been solved at that station by supplying each sub-station or feeding point by two feeders, either with two distinct circuits, each able to carry half the load or by connecting together two sub-stations, each of which have separate feeders, or by running radial feeders and connecting the several feeding points to corresponding feeding points on an adjacent feeder by the distributing mains; instead of the fuses at the feeding points of the feeder there are discriminating cut-outs, so that no amount of current in the normal direction will open them, but a relatively small return current will immediately release them; such a cut-out can be relied upon to operate only when it is required to do so; they must be made so as not to operate if either the series or shunt current is interrupted separately or simultaneously, as it would otherwise cause much trouble if the supply were stopped for a few seconds, causing all the cut-outs on the mains to operate. He prefers a weight to a spring; it should cut out with as small a current as possible, so as to prevent excessive arcing. The object of an excess cut-out between the primary of a transformer and the mains should be to protect the mains from being short circuited by the transformer and not to prevent the transformer from being overloaded; the transformer fuse should not blow unless the current exceeds about 300 per cent. of the normal; fuses between the secondaries of the transformers and the secondary bus bars are worse than useless; they should be replaced by discriminating cut-outs. A diagram is given of the equipment of a sub-station. Sub-stations under the pavement are being abandoned by his station; he is uncertain whether it is advisable to equip low tension distributers with cut-outs or not; he questions whether the numerous cut-outs in a system tend to reduce the fire risk; if no branch fuses are used the entire house wiring should be enclosed in a fireproof conduit, and this would tend to prevent interruptions and reduce the fire risk.

PROTECTION OF THREE-WIRE SYSTEM.—Lond. "Elec. Eng.," May 6.—Descriptions of several ways of protecting the lamps on one side of a three-wire system leading into large buildings; in such a case, when the middle fuse of the house main blows there is danger of destroying the lamps on the two sides. It is claimed that the only safe and reliable method is to abolish the fuse of the middle wire. Another method is to divide the middle wire into two branches, each having its separate fuse and leading off with one of the outer wires to one floor and with the other wire to another floor.

Electro-Physics and Magnetism.

RESEARCHES WITH THE ELECTRIC ARC. Sahulka. "Zeit. fuer Elek.," May 1.—Several years ago he described some researches in which he obtained a constant current from an alternating current arc; in the present article he refers to some further experiments and the explanation of the phenomenon. If an arc is formed by an alternating current between two carbon electrodes, and if a small rod of carbon is then introduced into the arc, a continuous current will flow between this rod and one of the carbons. The E. M. F. becomes smaller as the rod is withdrawn, and is greatest when the rod reaches the centre of the arc; the arc is always negative as compared with the electrodes; with the aid of a sensitive mirror galvanometer and a high resistance in the branch circuit continuous E. M. Fs. up to 13 volts were noticed. He suggests that the phenomenon may be explained as a thermo-electric one; another explanation offered is based on a principle similar to that in the experiment with aluminum and carbon, in which a current from the former to the latter, through a liquid, develops a counter E. M. F. of 22 volts, while in the opposite direction there is no such counter E. M. F. Gold repeated his experiments, using a copper voltameter in place of a galvanometer and believed that the continuous current was due to oscillating changes of resistances in the arc. The results of further investigations by the present author are given in tables; some of these were made with an alternating arc between copper and carbon, from which a constant current was obtained, running from the copper to the carbon in the arc; the continuous current was about 60 per cent. of the alternating. In an arc between carbon and mercury the continuous current flowed from the carbon to the mercury in the outside circuit; the continuous E. M. F. was always about 40 volts.

RESISTANCE OF BISMUTH. Van Aubel. "L'Eclairage Elec.," April 30.—A long extract with a full page table of an article from a French physical journal, giving the results of recent researches. It seems to be the same article that was noticed in the "Digest" recently, and appears to contain much valuable information.

ELECTRIC PROPERTY OF GLASS. Gray and Dobbie. "Proc. Royal Soc.," April 20; abstracted in the Lond. "Elec.," May 6.—The first installment of their work, which was undertaken to determine the circumstances which affect the conductivity and specific inductive capacity of glass. The conductivity decreases quite regularly as the amount of lead oxide increases, whereas it rose with the amount of soda; the glass which possessed the highest specific resistance, namely, 8400×10 to the 10th power ohms, contains 40.5 per cent. of lead oxide, 7.5 per cent of potassium oxide and 2.1 per cent. of sodium oxide; with a still higher percentage of lead and almost entire freedom from soda the electrical resistance was too high to be measured (although the figure above given was said to be the highest specific resistance). A glass whose composition is expressed by a simple chemical formula invariably has a high resistance.

VOLTA ELECTRICITY OF METALS. Erskine-Murray. "Phil. Mag.," May.—A very long article describing his experimental investigation, the object of which was "the elucidation and measurement of the variations of volta contact electricity of a pair of conductors, due to changes in the state of that portion of the surface of each conductor which was separated from the other conductor by an insulating medium."

FRICTIONAL ELECTRICITY. Coehn. "L'Eclairage Elec.," April 30; abstracted from the "Wied. Ann.," 64, page 217.—He determined the sign of the electrification of various liquids in contact with glass, and gives also their inductive power; there are comparatively few of the more common liquids in the list.

ELECTROMAGNETIC INDUCTION. Bryan. "Phil. Mag.," May.—The second part of his mathematical paper read before the

Physical Society on electromagnetic induction in plane, cylindrical and spherical current sheets, and its representation by moving trails of images.

ELECTRO-DYNAMIC PHENOMENA. Bjerknes. "Wied. Ann.," 58, page 91; abstracted in "L'Eclairage Elec.," April 30.—He shows how these phenomena may be represented by pulsating and oscillating spheres.

DEFORMATION OF A DIELECTRIC. Sacerdote. "L'Eclairage Elec.," April 30.—An Academy paper on the deformations of a solid dielectric in an electric field; it is of a theoretical nature.

UNIPOLAR DISCHARGES. Battelli. "Nuovo Cimento," February; abstracted briefly in Lond. "Elec.," May 6.—When the two electrodes of a tube are connected to the same terminal of an influence machine or induction coil and the sparks are of a suitable length, the whole of the tube lights up with the exception of a perfectly dark zone in the centre. He investigated this phenomena and describes a large number of additional experiments.

URANIUM AND THORIUM RAYS. Mme. Curie. "L'Eclairage Elec.," April 30.—An Academy paper describing researches with compounds of uranium and thorium and giving a table of results. All the compounds of uranium which were examined were found to be active and in general the more so the more uranium they contain; the compounds of thorium are very active, the oxide being even more so than metallic uranium.

INCREASING THE INTENSITY OF X-RAYS. Garrigou. "L'Eclairage Elec.," April 30.—A reprint of an Academy note in which he describes a method of condensing the rays, thereby increasing their action; the description is not quite clear.

SUSCEPTIBILITY OF DIAMAGNETIC AND WEAKLY MAGNETIC SUBSTANCES. Wills. "Phil. Mag.," May.—A description of the apparatus used and results obtained in his investigation, in which he endeavored to determine the susceptibility of bodies in which it is extremely small and either positive or negative; he gives the results with quite a number of substances. The method appears to be based on the fact that if a substance be introduced into a field which is not homogeneous a mechanical force is exerted which makes it enter a stronger or weaker part of the field, according as the substance is magnetic or diamagnetic, the distribution of the field being known. Thin rectangular slabs of the material were used, and they were suspended between the horizontal poles of the magnet from the arm of a balance. The theory of the method is also given.

ELECTROMAGNETIC SCREENING. Maurain. "L'Eclairage Elec.," April 30.—The conclusion of his article (see "Digest," April 30).

ADJUSTABLE X-RAY TUBES. Swinton. "Elec. Eng.," May 12.—A reprint of his paper before the Röntgen Society, read some time ago, and noticed in the "Digest" at that time.

MAGNETIC WIND.—"Sc. Am. Sup.," May 21.—A reprint of the abstract of Lehmann's recent article, which was noticed in the "Digest," February 26.

ALTERNATING CURRENTS. Fry. "Jour. of El'ty," April.—An article explaining in a general and elementary way some points in the theory of alternating currents, with very little use of mathematics, but free use of diagrams.

Electro-Chemistry and Batteries.

DRY STORAGE BATTERIES.—"Elektrochem. Zeit.," May.—Some brief references, without further descriptions, of some dry cells which can be recharged by means of a current. The electrodes are not dissolved, and there is no sulphuric acid used; the E. M. F. is about 1.1 volts, the resistance 3.5 ohms, the capacity 6 to 8 ampere hours; the charging is done with a current of 5 amperes; the cell is 145 mm high and 75 mm in diameter. Another kind has an E. M. F. of 1.5 volts. A certain dry primary cell which may be used on open circuit has an E. M. F. of 1.75 to 1.8 volts; it has very strong recuperative properties, as it will recover quickly after it has been short circuited for several hours. A cell giving 1.8 volts and 30 amperes on short circuit is mentioned. A wet cell is mentioned in which the hydrogen is not absorbed, but is set free without a depolarizer.

RIBBE ACCUMULATOR.—"Elektrochem. Zeit.," May.—A short, illustrated description of this portable accumulator. According to the measurement of the Reichsanstalt the cell weighed 15.4 pounds, and at a 12-hour discharge yielded 92 ampere hours. A battery for a car, consisting of 132 cells, yielding 300 ampere hours at a 16-hour rate, weighs 7040 pounds. The plates are covered with sheets of perforated celluloid, which are securely attached to the plate through holes passing through the plate.

ELECTRIC CONDUCTIVITY OF PERMANGANATE OF POTASSIUM SOLUTIONS. Legrande. "L'Eclairage Elec.," April 30.—A reprint of his Academy paper, with the table of results.

HYDROLYTIC AND ELECTROLYTIC DISSOCIATION. Platner. "Elektrochem. Zeit.," May.—An article supplementary to his recent one, and giving further facts.

ORGANIC ELECTRO-CHEMISTRY. Krueger. "Elektrochem. Zeit.," May.—A long continuation of his article on the progress in this field.

ELECTRO-CHEMICAL INDUSTRIES OF EUROPE. Kershaw. "El'ty," May 11.—In this continuation of his long serial he discusses bullion refining. In the issue of May 18 he gives the first of two short articles in which he shows certain photographs of electro-chemical installations in England, accompanied by very brief descriptions; the present is on the Castner-Kellner Alkali Company's plants.

ELECTROLYTIC REFINING OF LEAD. Cowper-Coles. "El'ty," May 18.—A reprint of the article noticed in the "Digest," May 14.

ELECTROLYZED SEA WATER. Hedenberg. "El'ty," May 18.—Short descriptions of the Woolf plant at Brewsters and of the Hermite system, for purifying sewage.

Units, Measurements and Instruments.

FUNCTION OF INDUCTION COIL CONDENSER. Mizuno. "Phil. Mag.," May.—The commonly accepted explanation of the action of a condenser in an induction coil gives only an imperfect account of its function; he therefore made some investigations which are described in the article; his object was to examine the effects which variations of the capacity of a condenser in the primary circuit produced on the maximum spark lengths when the primary current is kept constant. The condenser was made to shunt the spark gap; the interruptions were made by hand; a series of observations were made, with increasing capacities for each of a number of currents, and the results are given in tables and curves for two different coils. The curves all rise abruptly, reaching a maximum, and then fall gradually, and they are similar for all the currents; they indicate that for a given primary current there is a corresponding definite capacity which gives the maximum spark length; the capacity for maximum spark length becomes greater as the current increases; below the maximum point the effect of the capacity is to increase the secondary spark lengths at a much greater rate than it diminishes them beyond this point; an insufficient as well as an excessive capacity therefore spoils the action of the coils, and from this it follows that it is necessary to carefully find out by experiment the best capacity for each coil, before constructing the condenser; the maximum varies with the current, and therefore the capacity ought to be that which gives a maximum resonance effect for the strongest possible current allowable for the primary circuit. Walter recently published a paper on the same subject, and from theoretical considerations concluded that the maximum secondary voltage is equal to the primary current multiplied by the square root of the ratio of the coefficient of self-induction of the secondary circuit to the capacity of the condenser in the primary; the present author, however, states that this does not appear to be valid, as his researches show a wide discrepancy between the theoretical and the observed results. Much more experimenting will be necessary in order to elaborate the theory of the induction coil.

ELECTRICAL ALLOYS. Appleyard. Lond. "Elec. Rev.," May 6.—The conclusion of his article (see "Digest," May 14). The question of new alloys is discussed, the chief object being to diminish the temperature coefficient. The investigations of the Reichsanstalt are described, and a number of curves and results are given. The practical results of the investigation showed a possibility of obtaining two kinds of alloys with vanishing temperature coefficients; with manganese and copper only 7 per cent. of manganese is required to produce an alloy of infinitesimal temperature coefficient; in practice 12 parts of manganese, 2 of nickel and 86 of copper are adopted, and this alloy is named manganin; the nickel has the effect of raising the thermo-electric force against copper, beside improving the temperature coefficient. The change in resistance of a 1 ohm coil at various temperatures is shown by a curve. There are two alloys of nickel and copper for which the temperature coefficient vanishes; one of these, called constantan, contains 40 per cent. of nickel; a trace of nickel, added to a certain manganese copper alloy, gets rid of the small negative value of the thermo-electric power against copper; nickel-copper, and especially constantan, have high thermo-electric power against copper; the values are given in a curve; the thermo-electric power of manganin against copper is zero, but this alloy is easily oxidized; it can now be drawn cold, lessening the trouble due to oxidation; when covered with shellac it will not oxidize subsequently below 150° C.; constantan resists oxidation even up to 300° C.; its qualities are of great value where considerable heating is expected, but for resistance standards manganin takes preference. Tin solder should not be used with manganin, as it produces subsequent changes in the resistance; silver solder is used now; the wire should not be touched by the hand in winding, and bending should be avoided as much as possible, for which reason several thinner wires are used in preference to a thick one.

COMMERCIAL FORMS OF ELECTRICAL RESISTANCES. Atkinson. Lond. "Elec.," May 6.—An important error is pointed out in his article, which was noticed in the "Digest," May 14; this error was reproduced in our abstract. It was stated that 10 square inches should be allowed per watt dissipated, whereas it should read 1 square inch. The reprint of the article is concluded in the Lond. "Elec. Rev.," May 6.

ALKALIMETRIC GALVANOMETER. Cardani. "Nuovo Cimento," February; abstracted in the Lond. "Elec.," May 6.—He describes a novel method of measuring the quantity of electricity discharged by a condenser; the method is said to be extremely accurate and sensitive. It consists in a micro-chemical quantitative analysis of the products of electrolysis in a voltameter. The quantity of electricity is so extremely small that it would require thousands of

discharges to produce an electrolytic deposit capable of being weighed in a balance; he therefore uses the volumetric method and solutions, which are one-hundredths of the normal; quantities of sodium as small as 0.000005 gram are clearly indicated. Applying it to a condenser discharge, he uses a saline solution which is turned alkaline by electrolysis; a 10 per cent. solution of sodium cloride is used, a few drops of oxalic acid being added to neutralize the original alkalinity; the solution should possess a slight initial coloration; a small amount of dilute oxalic acid of known strength is then added to make it colorless, and after the discharge is passed the amount of caustic soda solution which is necessary to reduce the liquid to its original color is measured; the difference between the two quantities is due to the alkalinity produced by the discharge. For a battery of ten condensers (size not given in the abstract) the number of coulombs per spark was found to average 0.000522. One result confirms the statement that the discharge of a condenser diminishes as the resistance in the circuit increases.

MEASURING THE EFFICIENCY OF DIRECT CURRENT MACHINES. Poynder. Lond. "Elec. Rev.," May 6.—A criticism of the method suggested by Dupuy and described in the "Digest," February 19 (see also May 14). He believes that there is an error in this method of calculation; the same test is described in Thompson's book on dynamos, where it is accredited to Kapp and where the formula given is different. Dupuy seems to have overlooked the fact that the currents in the two machines are not equal; in connection with the Joule effect the current in the motor is in excess of that in the generator by the amount supplied by the third machine. The present writer assumes that the efficiency obtained is that of either machine at an output between the arithmetical mean and the root mean square of the sum of the two currents and the main current; with the figures given by Dupuy the efficiency would be 0.929 instead of 0.92, and the difference between the two methods is greater the lower the efficiency. The present writer has used the test for some time past, and endorses the statement as to its convenience, but he found two objections, one being that the speed drops below the normal and the second that the weakening of the field of the motor produces sparking, especially with toothed armatures; the latter effect may be lessened by connecting the field cores of the generator, when more than one, in parallel and inserting a resistance, which is then cut out, thus strengthening the field, while that of the motor is weakened, but this further reduces the speed. The waste in the leads, switch and ammeter can easily amount to 1 or 2 per cent. A method of an approximately correct allowance is described and an example given. The test is applicable to compound machines as well as to shunt, but care must be taken that the series turns are connected cumulatively on both motor and generator.

TESTING CABLE JOINTS. Raymond-Barker. Lond. "Elec.," May 6.—A short article describing a method of testing which he devised some years ago. The joint and the standard core are tested simultaneously; it is practically an accumulation zero method.

LEGALIZING ELECTRICAL UNITS.—"Elek. Zeit.," May 5.—An editorial containing a petition to the German Government requesting it to make changes in the proposed bill (see "Digest," April 23,) before adoption; in this bill the ohm, ampere and volt were defined, but not the watt, nor the watthour, which are the units by which electricity is measured in commerce; moreover, with alternating currents the watts are not always equal to the volts multiplied by the amperes; according to the requirements of the bill all the properly constructed alternating current meters would be forbidden. A protest is also made against the spelling of the word "amper." The latter was changed, but the other changes regarding the watt were not adopted. Kohlrausch, the president of the Reichsanstalt, claiming that the three units sufficed; it seems that the bill has been passed.

METER.—Lond. "Lightning," May 5.—In a short article describing the works of James White, where all of Lord Kelvin's instruments are made, a brief illustrated description of the new form of his meter is given.

RESEARCH LABORATORIES. Goss. "Elec. Rev.," May 18.—A reprint of an article on "The Engineering Research Laboratory in Its Relation to the Public," in which he points out the need in this country of proper research laboratories.

Telegraphy, Telephony and Signals.

TELEPHONE PRACTICE.—Lond. "Elec.," May 6.—An editorial note commenting on American practice as shown in three descriptions of American exchanges in that issue. It is claimed that a clumsy system of transfer working is used instead of multiple switching, at the new John Street exchange, in New York City; nearly every local connection in this 1200 subscriber exchange would have to be dealt with by two operators, which is distinctly a retrograde step; the breastplate transmitter is very little used in America, "in spite of its obvious convenience;" the number of operators is relatively less than in England; at La Crosse there is one operator for 100 subscribers, in John Street exchange, New York, sixteen operators serve 1200 subscribers, and in St. Louis three attend to 260 subscribers; in the Avenue and Bank exchanges, in London, the number of subscribers per operator is fifty, and the mean of all the metropolitan exchanges is 52.5; in Leeds and Liverpool it is 66 during the busy hours of the day, and in Manchester 50. In conclusion it states: "Are the American operators smarter than the English ones, or is it that the subscribers are more patient?"

STRATEGIC VALUE OF CABLES.—Lond. "Elec. Rev.," May 6.—A short article discussing the question of cutting cables during times of war, showing that the convention for the protection of submarine cables in Paris in 1884 did not restrict in any way the freedom of action of belligerents. The advantages of a cable from Canada to Australia through the Pacific are pointed out and attention is called to the economy of separate systems of cables as compared with the alternative of using a large number of cruisers for patrol duty.

TELEGRAPH ROUTES TO SPAIN AND THE WEST INDIES.—Lond. "Elec. Rev.," May 6.—A list of the various submarine cable systems which may be affected by the present war, and the names of the proprietors.

TRAIN SIGNALLING. Dieudonne. "Elek.," May 11.—A brief description from the French of the Claussen and Banian system, by means of which a train which has stopped can signal to others on the same track or to stations. It consists merely in establishing a closed circuit in sections on poles along the track, and including the semaphore signals or stations; there are switches in this circuit near the bottoms of the poles; a battery is kept on each tram, and when this is inserted in the circuit at the switch the signals are operated; by inserting a telephone communication can be established.

TELEPHONY.—"Elec. Engineering," May 15.—A long article on the large opposition telephone exchanges in St. Louis, and a number of short notes adverse to the independent telephone movement.

INTERMITTENT SWITCHBOARDS FOR SERIES TOLL LINES. Clausen. "West. Elec.," May 13.—A short, illustrated article describing a method which is adapted to be used by inexperienced people.

Miscellaneous.

PRODUCING HIGH TEMPERATURES WITH ALUMINUM. Goldschmidt. "Elek. Anz." May 1.—An abstract of a paper read at the annual meeting of the German Electrochemical Society. He describes an interesting method of producing high temperatures by the combustion of aluminum with the aid of the oxygen chemically combined with a metal, as, for instance, in iron oxide; instead of aluminum, magnesium and calcium carbide can also be used; the effect was surprising; the mixture is ignited with a match, after which it burns away quietly. The furnace was made of an ordinary wooden bucket lined with sand, and an iron rivet weighing 6.6 pounds was readily heated. The method is specially well adapted for hard soldering or brazing; the cost of the process is small, as only very little aluminum is consumed, and a cheap variety can be used; the cost of brazing a flange on a 3-inch iron tube was scarcely 4 cents. Pure wrought iron can also be produced in this way, and the method can therefore be used for welding; large holes can also be melted through thick wrought iron plates; the process is of value in metallurgy, as in this way it is now possible, by varying the mixture, to obtain certain pure melted metals free from carbon, which it was formerly impossible to produce; a piece of metallic chromium weighing 55 pounds and produced in this way was exhibited. The temperature was said to be about 3000° C.; the energy consumed in one of the experiments was estimated to be 2000 horse-power (hours?), as it was equal to the amount which was necessary to produce that quantity of aluminum; alloys of iron with boron, titanium, alloys of chromium and copper, etc., were shown; the slag is also of interest, as it is artificial corundum and is very much harder than the natural variety; it may be used again for producing aluminum. As a by-product there were artificial rubies, although they were only quite small. The action of aluminum with sulphates is so violent as to be almost explosive. The method forms a means of storing energy in aluminum.

EFFECTS OF THE ARC ON EYES. Trautsch. "Zeit. f. Beleucht," April 30.—An abstract of his recent report giving the results of investigations in connection with the operation of the Zerener arc welding process, which is now coming into use quite largely. The operator wears a pair of spectacles of dark, smoked glass, beside which he looks through a pane of deep red glass, which is connected with the apparatus. The action of the light is sufficiently reduced by this means; he tried using the red glass alone, but it affected the eyes for some time after. The workmen who are using this apparatus continuously at first experienced pain in the eyes at night, but later on this disappeared; the sight, however, was not affected. He concludes that no permanent ill effects are produced if proper precautions are taken, and if the operator becomes gradually accustomed to the work; it is a mistake to have a new operator work a whole day with the arc, as he should begin with a few hours a day until his eyes have become accustomed to it; only those which have healthy, normal eyes should attempt this work.

JAPAN.—"Elec. Rev.," May 18.—A short article pointing out recent electrical progress in that country.

MECHANICAL APPLICATIONS. Richard. "L'Eclairage Elec.," April 30.—A number of well illustrated descriptions of various applications taken from patent specifications.

RECENT USES OF ELECTRICITY IN MEDICINE. Jones. "Jour. of El'ty," April.—A collection of abstracts from various sources.

A Sixty-Cycle Rotary Converter.

In the station of the Pennsylvania Heat, Light & Power Company, Philadelphia, Pa., has recently been installed by the General Electric Company the largest sixty-cycle rotary converter yet constructed. It is a sixteen-pole machine, of 400-kw capacity, running at 450 revolutions per minute, and was designed to convert an alternating two-phase current of sixty cycles frequency and voltage variable betwen 165 and 220 volts, into continuous current at from 225 to 300 volts. It is designated Q C 16-400-450 and stands 8 feet high on a base 8 feet 4 inches x 8 feet 6 inches.

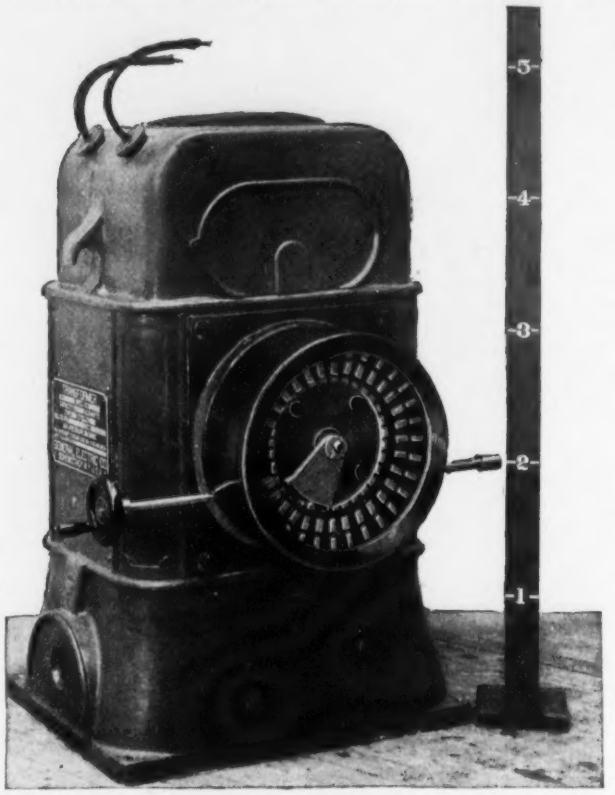
The field frame of this machine is heavily ribbed, divided horizontally and susceptible of movement along the base to allow of inspection of the armature and filed coils. The bearings are extra long and of the G. E. self-oiling and self-aligning type, that at the commutator end of the shaft being provided with an end play device to keep the armature in constant motion in the direction of the length of the shaft and distribute the wear of the brushes over the commutator surface to avoid the wearing of grooves. The armature is of the iron-clad type.

The commutator, carried on a separate spider, is of very ample surface and has a large number of segments. To facilitate the removal of a brush for examination and replacement without varying the tension under which it runs a brush holder of unique design has been devised. To remove the brush the prolonged end of the brush holder-spring is disengaged from the brush holder by a slight end motion.

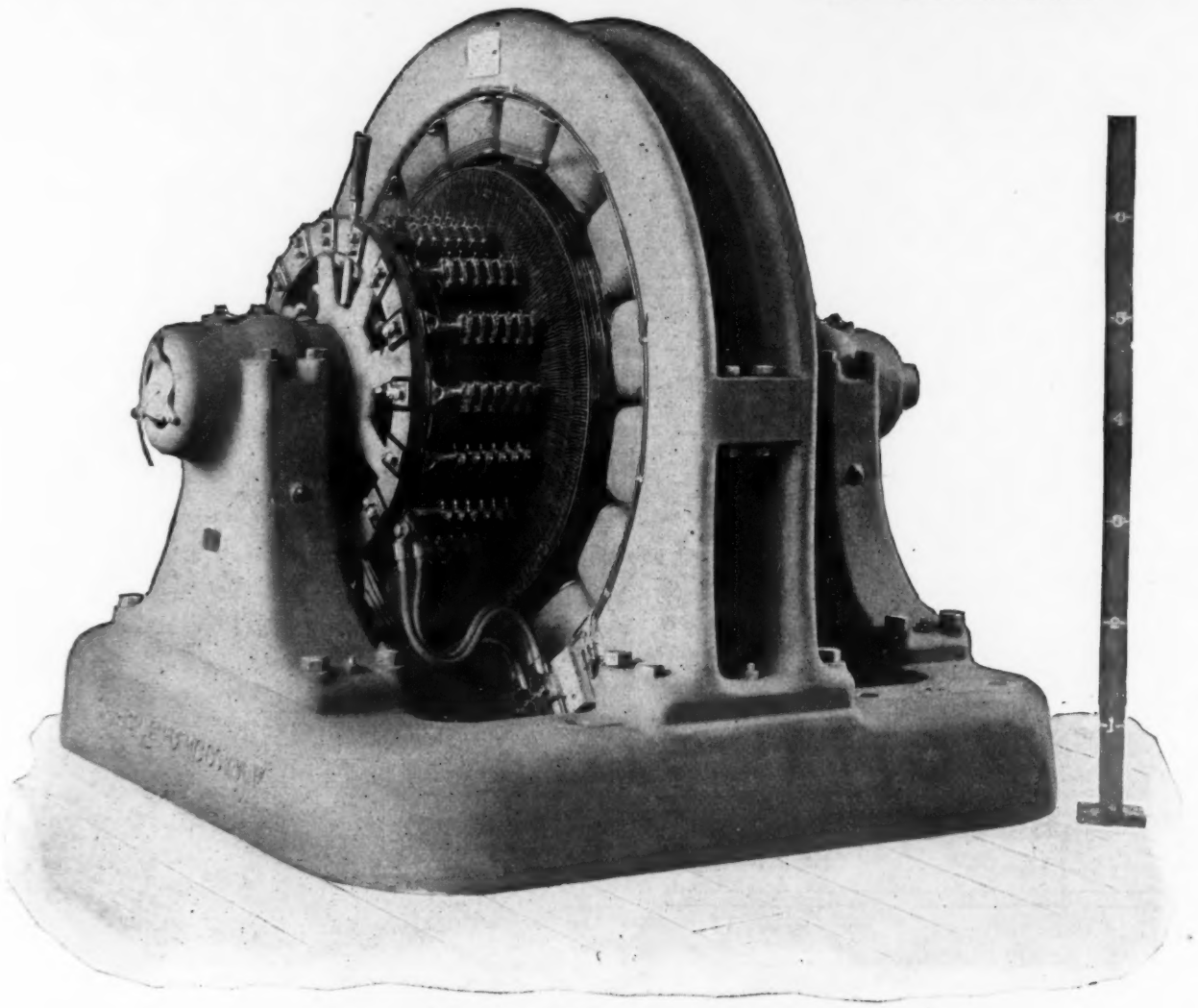
Another valuable feature in this machine is the design of the brush-holder studs and the method of attaching them to the yoke. The former, instead of passing through insulating bushings in the yoke—as has been customary in this type of machine—is provided with a lug bored to fit down upon a radial stud held by bolts passing through the insulating bushings. To slide the brush-holder stud off it is simply necessary to loosen the nuts on the bolts passing through the bushings. By employing this method all labor and expenditure of time usually consumed in removing the insulating bushings and washers from the brush-holder yoke to remove the stud are avoided, and the change can be effected in a very few minutes.

To obtain the necessary variation in the continuous current of the rotary converter the General Electric Company has furnished with it two special sixty-cycle transformers, each of 220-kw capacity. These have been designed to operate with a primary potential of 2000 volts, and a secondary potential varying from 165 to 220 volts. The variation is obtained through a dial switch over which passes a contact plate cutting out or throwing in more or less turns of the primary winding and thereby varying the secondary potential. The switch is operated by a wheel handle, and the potential may be varied rapidly in either direction, the contact plate snapping from contact to contact in one direction as well as in the other. The dial switch is applied to the transformer itself instead of being a separate device, and the entire construction is singularly compact.

The rotary converter before shipment was subjected to a more than usually severe test. It is now operating satisfactorily in the station, running under heavy loads without sparking or cutting at either the commutator or collector rings.



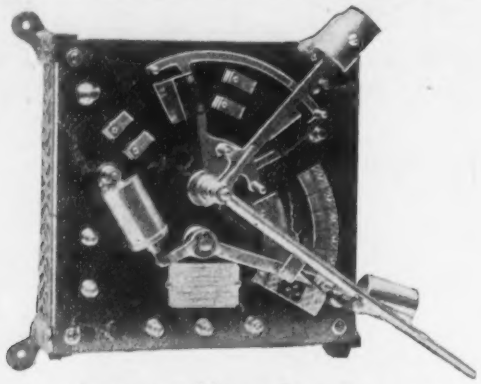
SIXTY-CYCLE TRANSFORMER.



SIXTY-CYCLE ROTARY CONVERTER.

New Type of Automatic Motor Starter.

We illustrate herewith a new type of automatic motor starter, which has just been put upon the market by Messrs. Zimdars & Hunt, 127 Fifth Avenue,



Automatic Motor Starter.

New York. This device is extremely simple in its operation, and has many features which should recommend it to prospective users of such apparatus.

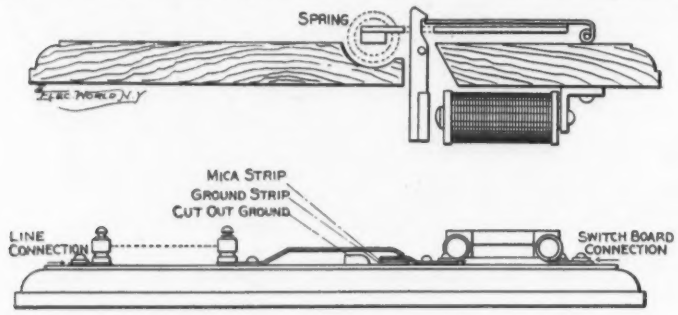
The various operations required to properly start a motor are accomplished automatically by the interaction of a number of suitably disposed levers, two of which are weighted. In operating, the main arm is raised (by rope or other suitable means), and this carries the rheostat lever up over the rheostat contacts, inserting the full starting resistance into the armature circuit. Immediately the rheostat lever reaches the top contact the main knife switch is closed, the field energized and the circuit closed through the armature and its starting resistance. At the time the main switch is closed the rheostat lever is automatically released and travels downward, under the action of gravity, over the rheostat contacts, gradually cutting out the starting resistance. The rate of travel of this rheostat lever can be regulated over a wide range by a pivoted air dash pot of improved form. The point of release can also be adjusted with relation to the time of closing of the main switch.

This starter bears evidence of careful design throughout, the absence of springs, solenoids and other devices of this character being especially noticeable. The details are representative of the latest and most opposed practice, all contacts, as an instance, being of the knife form, with those of the rheostat being capable of adjustment. The workmanship on these articles is up to the standard maintained by this firm and calls for no further comment.

For motors operating on elevator, pump, crane, blower and such other work these starters should be found especially desirable.

An Automatic Lightning Arrester.

The apparatus illustrated herewith, which is made by the Keystone Telephone Company, Pittsburg, Pa., will, it is stated, successfully prevent all heavy currents from reaching telephone switchboards. This automatic arrester has



Cross-Section and End Views of Lightning Arrester.

been in service for about a year, and its value as a protector against heavy currents has been demonstrated on many occasions.

The action of the arrester is as follows: The line comes from the cable terminals to the cross connection board, through the two binding posts along the automatic spring, over the ground strip, which is insulated from the line spring by a thin piece of perforated mica. It is then conducted through the electromagnet. The action of the electromagnet releases the spring, which throws open all the cut-outs on the board by the raising of the cut-out ground strip. All the lines are then grounded, and the switchboard operator can in a moment cut out the overcharged line, pull down the spring into place and the system is then again in service. A push button is provided on the switchboard, which is used by the operator in case a fluttering of the drops is noticed. By closing the circuit at the push button the battery current is thrown into the electromagnet, thus opening the arrester.

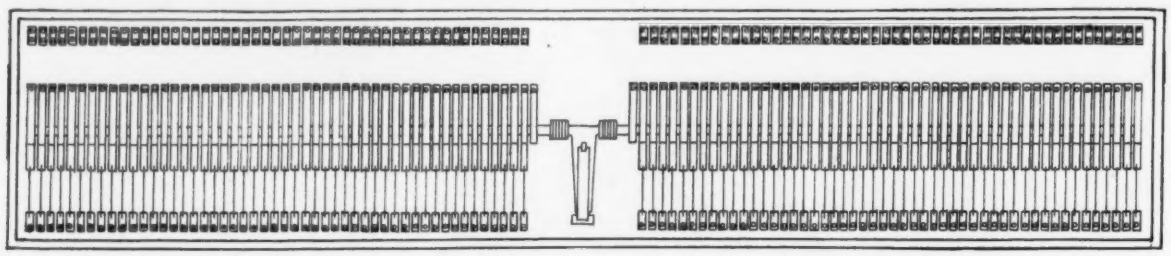
This arrester, it is stated, is fully covered by broad patents, which are controlled absolutely by the Keystone Telephone Company. It is recommended as being better than fire insurance and costs much less in the long run.

Automatic Cut-Off Engine.

The modern steam engine for electric work is an excellent example of mechanical refinement. It has been evolved from the comparatively crude machine of a few years ago to meet the exacting requirements of electric lighting and power, and its ability to take care of varying loads under continuous service places it in the category of fine mechanism.

The medium speed automatic cut off engine, built by the Erie Engine Works, Erie, Pa., is a machine that has several points of merit, which entitle it to the favorable consideration of managers of electric light and electric power stations. These engines are recommended by the manufacturer for their economical development of steam power and their close regulation, combined with the advantages of economy of fuel, high class workmanship, simplicity and durability.

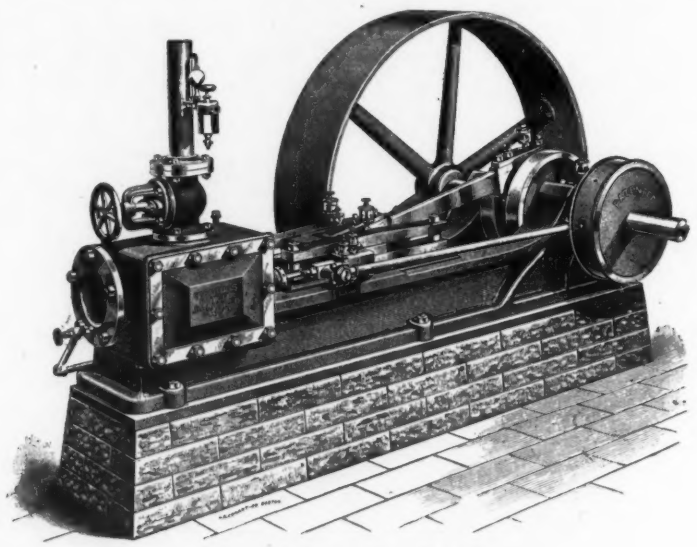
The Giddings patent equilibrium valve is used on these engines. This valve embodies the safety valve principle, is free to leave the seat one-eighth of an inch in case of water in the cylinder, and, it is stated, has never caused a break. It is double ported and permits of a very close approximation to boiler pressure in the cylinder. Live steam holds it to its seat, thus insuring a tight joint.



One-Hundred-Line Automatic Lightning Arrester.

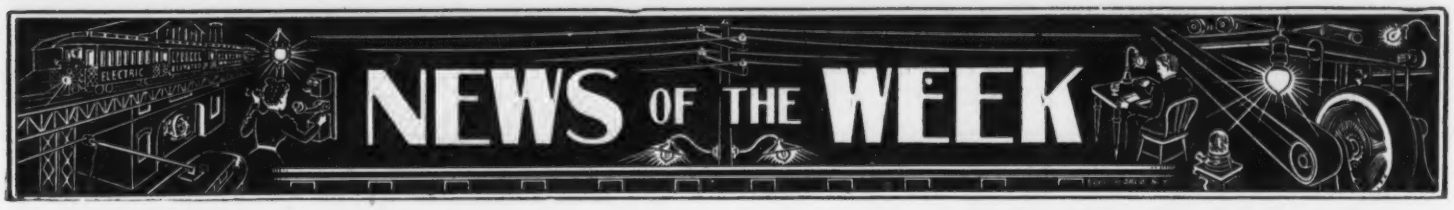
The cranks are solid forgings, and the connecting rods and straps wrought forgings. The cylinders are set low on the beds, special attention having been paid to have the arrangement of the steam chest, ports and exhausts so as to secure the most perfect draining.

The engine is provided with a new automatic governor, which embodies valuable features, and has, it is stated, stood the test of years of active service. The rope eccentric sheave shown in the illustration rotates the inner eccentric by means of a split crosshead, which serves as the eccentric strap, thereby converting the rotary movement of the inner eccentric to a reciprocating movement



Automatic Cut-Off Engine.

of the yoke, inside of which the crosshead works and to which the main eccentric is attached. This gives a large degree of sensibility to the governor, which is free from fluctuation or racing. The governor varies the amount of steam admitted to the engine according to the variation of both the load and boiler pressure, giving a constantly uniform speed and using the steam at the best. The position of the governor with reference to the other parts of the engine is immediately adjacent to the eccentric, and both are keyed to the shaft on the end opposite that to which the fly wheel is attached.



Financial Intelligence.

THE CAPITAL of the Cincinnati & Hamilton Electric Railway Company has been increased from $350,000 to $600,000.

THE APRIL REPORT of the Edison Electric Illuminating Company, of New York, shows gross earnings, inclusive of high tension systems, of $260,609.04, an increase of $54,466.11 over the same item of April last year. The net earnings were $120,796.86, an increase of $19,952.36.

IT IS REPORTED that the American Bell Telephone Company is contemplating a bond issue to take up the $2,000,000 debenture bonds which mature in August next. There is an outside opinion, however, that the bonds will be paid off at maturity from the company's surplus.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, May 23, 1898.

ELECTRICAL DEVELOPMENTS IN JAPAN.—On the evening of May 19, Prof. I. Fujioka, of Tokio, Japan, gave a lecture before the New York Electrical Society on the subject of "Electrical Developments in Tokio City and the Kingdom of Japan. The meeting was held in the concert room, Madison Square Garden, and was one of the society's exhibition series. The lecture was illustrated by lantern slide views of Japan, etc.

A NEW TELEPHONE EXCHANGE.—The New York Telephone Company has completed plans for the erection of a new exchange at No. 112 West Eighty-ninth Street. The new building in which the exchange will be located will cost $50,000, plans for the same having being filed by Architect C. L. W. Edlitz. This exchange is intended to serve a section of the West Side which is now taken care of by the "Columbus" and "Harlem" exchanges, the former being on West Fifty-ninth Street and the latter on 125th Street.

THE ANNUAL business meeting of the American Institute of Electrical Engineers was held at 12 West Thirty-first Street on May 17. After the annual reports were read the tellers, Messrs. Townsend Wolcott and J. P. Wintringham, announced the results of the election as follows: President, Arthur E. Kennelly; vice-presidents, Robert B. Owens, William Stanley, Cary T. Hutchinson; managers, Herbert Lloyd, Samuel Sheldon, George F. Sever, Charles P. Steinmetz; secretary, Ralph W. Pope; treasurer, George A. Hamilton. All of the new officers were council nominees. The annual report of Secretary Pope shows that the total membership on April 30, this year, was 1098, a net gain of twenty-five. At the meeting of the executive committee in the afternoon the following named associate members were elected: Felix Louis Cadou, superintendent and electrician Washington Street Railway Company, Washington, Ind.; Thomas Dempster, electrical engineer, General Electric Company, Schenectady, N. Y.; Paul Letheule, electrical engineer, commissioned by French Government, 24 Front Street, Schenectady, N. Y.; Livingston Johnston, Jr., Islip, N. Y.; Howard Joslyn, assistant engineer, Snoqualmie Falls Power Company, Seattle, Wash.; James J. Mahony, engineering assistant to manager railway department General Electric Company, New York City; Irving A. Taylor, motor inspector, Edison Electric Illuminating Company, Brooklyn, N. Y.; Wallace Rupert Turnbull, foreman of experimental room, General Electric Lamp Works; James H. Winfield, superintendent Eastern division, Nova Scotia Telephone Company, Ltd., New Glasgow, N. S.; Fred. W. Wood, general manager, Los Angeles Railway Company, Los Angeles, Cal.

THE RAPID TRANSIT QUESTION.—At the meeting of the Rapid Transit Commission on May 19, a letter was read from Mr. George J. Gould, president of the Manhattan Elevated Railroad Company, offering to accept six of the seven franchises laid out by the commission. In his letter Mr. Gould expresses his regret at the determination of the commission to withhold the Boulevard franchise. Nevertheless the Manhattan Company agrees to definite propositions relating to the other franchises. The first proposition is to build the West Street line within three years; second, to build the crosstown line from West Street to the City Hall within two years; third, the construction of additional tracks and facilities within five years; fourth, the construction of the Tremont & Bedford Park line, if not thwarted by the abutting owners, and complete the line within two years. A resolution was adopted by the board to the effect that while Mr. Gould's letter stated definitely what the Manhattan Company would do in some respects, it is quite indefinite as regards other matters. The board, in fact, did not really understand what the company proposed with reference to the construction of additional tracks and facilities. The board states that it is disposed to make concessions on the subject of rentals, but it is clearly of the opinion that these negotiations can never reach any practical results unless it follows the usual course. The board states that it has submitted definite propositions in writing to the Manhattan Railroad Company, and if that company will now submit definite counter propositions, complete in all their parts, the board will give them immediate attention. The only way, it states, to deal with this matter is for the Manhattan Company to amend the text of the proposition submitted to it by the rapid transit board, so as to show the precise modifications upon which that company insists.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., May 21 1898.

WHITMAN & COUCH, the well-known telephone manufacturers of Boston, have sold quite a number of their telephones to the War Department for coast use, and additional orders are still being received. This firm is about placing on the market an important specialty—a double-pole bell-shaped telephone receiver, with metal spools, adjusted so that the difference in atmospheric changes cannot affect it in any way. This important device was suggested through this firm's experience in exchanges under its control, and is said to prevent very many difficulties.

THE BELKNAP MOTOR COMPANY, Portland, Me., reports business as excellent. Orders for the Chapman Voltage Regulator are coming in quite rapidly, and what is particularly satisfactory to General Manager Brown is the fact that quite a number of duplicate orders are being received, the most recent and notable being duplicate orders from the Mount Morris Electric Light Company, of New York City, for seven additional regulators, and the Stanley Electric Manufacturing Company, of Pittsfield, for five additional. The Belknap Company is also quite busy on general work. It is installing in Portland a large electrical conveyor for loading and discharging wharf shipments. It is also conducting telephone installations along the Maine and Massachusetts coast, the telephones being of the well-known Whitman & Couch make.

THE LINTON MANUFACTURING COMPANY, 42 Lagrange Street, Worcester, Mass., has just announced itself for business. Its specialty will be the manufacture of switchboards and switches. The fact that this company is under the management and direction of Mr. George A. Linton is sufficient guarantee that its manufactures will meet with favor and business recognition by and from the electrical trade. Mr. Linton has for several years been connected with the firm of Linton & Southwick, from which he has severed his connection, disposing of his interest. He has a large personal following which of itself forms a good business nucleus for the Linton Manufacturing Company.

PHILADELPHIA NOTE.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., May 21, 1898.

A NATIONAL EXPOSITION of American products and manufactures, especially suited for export, will probably be held in this city in 1899. The exposition is to be held under the auspices of the Philadelphia Commercial Museum, which is a public institution receiving financial support from the City Councils of Philadelphia and the State of Pennsylvania. The Committee on Interstate and Foreign Commerce has recommended the passage of a bill by Congress to authorize and encourage the holding of the exposition.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., May 21, 1898.

IT IS REPORTED that the elaborate signal system at the Buffalo Traction Company's crossing of the Lehigh Valley Road, on Chicago Street, is working as well as could be expected, notwithstanding that the batteries run down very rapidly.

THE BOUGHTON TELEPHOTOS COMPANY, of Buffalo, has presented a complete set of its signaling apparatus to the dynamite cruiser "Buffalo," in recognition of the honor conferred on the city by the name. The works of the company are crowding on all possible force to keep up with the regular Government orders.

THE RAILROAD COMMISSIONERS are in Buffalo this week, having been summoned to adjust certain crossing disputes between the two city trolley lines. At this writing it appears likely that the differences will be settled by the companies themselves direct. The traction company is expected to begin extensive additions to its trackage as soon as these difficulties are settled.

MUCH DISAPPOINTMENT is expressed over the delay of private contracts in the building of electrical apparatus that has been occasioned by the rush of Government work on account of the war. The General Electric Company has been put back thirty to sixty days in its contract to furnish the apparatus for the Buffalo electric light station. All the conduit work leading up to the station has been completed and if the apparatus were ready the station could be used in a month or so.

SOME VERY INTERESTING and important tests of electrical apparatus are in progress at the Niagara power house this week. Following the lead of the General Electric Company in the invention of a new high-tension circuit breaker the Westinghouse Company has completed a simpler device which breaks the circuit without the employment of the long-fuse attachment. This latter was tested at the tunnel lately with entire success, and the Westinghouse invention has been tested this week, first at 2000 to 3000 volts and 3000 amperes by short-circuiting one of the 5000-hp generators. Experts present who have no interest in either invention say that both devices work well, the General Electric perhaps a little more smoothly, as ought to be the case considering

the larger amount of apparatus used. After testing the Westinghouse circuit breaker with the current at 3000 volts it was also tested at 10,000. Both the General Electric and the Westinghouse current breakers will be in use in Buffalo soon, the former in the new power house of the city lighting company and the latter in the Ohio Street transformer house of the conduit company.

PITTSBURG NOTES.

PITTSBURG, Pa., May 20, 1898.

BILL IN EQUITY FILED.—The Borough of North Braddock has filed a bill in equity against the Braddock Electric Railway Company, asking that the defendant company be compelled to remove its tracks from certain streets in the borough. It is claimed that the road was constructed without legal authority and that it is a nuisance, the line having been abandoned since January, 1896.

CONTRACT FOR THE MOUNT WASHINGTON TUNNEL.—The Pittsburg & Mansfield Railroad Company has awarded to Messrs. Curran & Hussey the contract for a large portion of the work to be done in the construction of its projected road. These contractors will build the large bridge across the Monongahela River from Ferry Street to Mount Washington. This bridge will have a channel span 840 feet long, and a span of 15 feet at the Pittsburg end. The approach at the Pittsburg end will consist of a viaduct 1100 feet long. The contract also includes a tunnel through Mount Washington 1800 feet long, and three viaducts beyond the tunnel. These viaducts will be 2000 feet long. 1000 feet long, and 300 feet long, respectively. The work will be completed, it is said, within a year.

MILWAUKEE NOTES.

MILWAUKEE, Wis., May 20, 1898.

THE WISCONSIN TELEPHONE COMPANY on May 13 quietly celebrated the nineteenth anniversary of its beginning business in this city.

THE BADGER STATE LONG DISTANCE TELEPHONE COMPANY has been organized at Baraboo with a capital of $100,000. The object of the company is to build and operate lines all over the State.

THE CHIPPEWA VALLEY ELECTRIC RAILROAD COMPANY has been organized at Eau Claire with a capital of $200,000. N. C. Wilcox is president of the new company, which is to build and operate the interurban line.

WORK ON THE Fox River Valley Electric Railway is being pushed, and it is hoped that the road will open on May 28, which would be in time for the G. A. R. encampment at Appleton. Work on the Oshkosh extension will be commenced soon.

MR. A. C. FROST, who tried hard to get a franchise to operate an electric street railway parallel to the present lines in this city, but failed, may try again with the new Council. He now says that if he is required to build bridges, widen streets, lay pavements, etc., he would not accept a franchise.

AN ORDINANCE to issue bonds for a municipal light and power plant in this city, after a lively discussion by the committee on finance, has been laid over. In view of the financial condition of the city it was argued that it was impracticable to consider the expenditure of $250,000 to start on the plant.

ST. LOUIS NOTES.

ST. LOUIS: Mo., May 20, 1898.

THE SOUTH BROADWAY MERCHANTS' ASSOCIATION has voted a fund to secure the passage of a bill for a loop railroad.

THE BOARD OF PUBLIC IMPROVEMENTS granted the electric lighting companies another hearing next Tuesday on the subject of placing wires in alleys. At the former hearing permission to string wires in this way was refused.

THE DEMANDS of the local union electricians for an increase in wages from $2.50 to $3 a day, to take effect June 1, is receiving the direct support of the National body and forty-seven local unions in St. Louis. J. H. Maloney, the National president and organizer of the Electrical Workers' Union, is in St. Louis.

THE BROADWAY CABLE ROAD is moving again to change its motive power to electricity, and will ask the municipal assembly for authority, as well as for an extension from its present Southern terminus to Carondelet. Bonds were floated and new rails laid a year ago, looking to these changes, and it is thought now they will be at once begun.

A DECISION in the case of the Peoples Railroad Company, which is pending in the Missouri Supreme Court, and which acted as a supercedeas to prevent the selling of the property at sheriff's sale, is expected in a few days. The bondholders may buy it in. They are not likely, however, to run it. They may turn it over to one or another of the existing systems for operation, or sell it outright.

THE SEDALIA ELECTRIC RAILWAY & LIGHT COMPANY has disposed of its entire plant to an Eastern syndicate for $350,000. F. W. Child, of New York, has been appointed general manager. The electric railway company owns 15 miles of track, one park of forty acres and another of 120 acres, while the lighting plant operates 160 arc and 200 incandescent lights. The property belonged to the estate of Judge D. C. Metzker, of Topeka, Kan.

TELEGRAPH WIRES NOT UNDER GROUND.—As yet neither the Western Union Telegraph nor Postal Telegraph Company has taken any step toward building underground conduits to carry their wires according to the terms of the Keyes ordinance. Both companies are beset with all sorts of perplexing questions. Just how the tangle will straighten itself out is a prediction which lawyers who have studied the situation will not venture to make.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., May 14, 1898.

THE TOWN of Republic, Wash., has been connected with Spokane by a telephone line 37 miles in length.

THE PACIFIC AUXILIARY FIRE ALARM COMPANY, San Francisco, has announced Dividend No. 19, of 5 cents upon each share of the capital stock of the company.

THE WESTERN UNION TELEGRAPH COMPANY'S cable, which will be laid across the Straits of San Juan de Fuca, from a point near Port Angeles, Wash., and Esquimault, near Victoria, B. C., has arrived at Tacoma, Wash. It occupied nine gondola cars. A vessel has been chartered to transport and lay the cable.

THE UNION LIGHT & POWER COMPANY, of Salt Lake City, Utah, which owns the Pioneer and the Big Cottonwood water power electric plants, recently announced a reduction of 25 per cent. on lighting by meter and on commercial arc lights. Twelve-o'clock arc lights will be cut from $10 to $7.50, the rate to take effect June 1.

THE COMMERCIAL LIGHT & POWER COMPANY, San Francisco, sustained less than $2000 damage from the fierce fire which recently raged in the building adjoining its central station on Commercial Street. The machines wer shut down only from 11 P. M. to 8 A. M. This was the company's second narrow escape from serious damage by fire and water.

CANADIAN NOTES.

OTTAWA, Ont., May 21, 1898.

THE EUGENE F. PHILLIPS ELECTRICAL WORKS, of Montreal, have been awarded the contract to supply all the trolley, bond and feed wire required in the construction of 25 miles of electric railway at Jamaica, W. I.

THE CITY ENGINEER of Toronto, Ont., has been negotiating with a company of Buffalo capitalists for the transmission of electric power to Toronto. The company offers to supply electric energy at $40 per horse-power per year, if the city guarantees that it will take not less than 10,000 horse-power. The company proposes to operate from a point 30 miles nearer Toronto than Niagara Falls.

MR. ELISHA MOORE, of Meductic, York County, New Brunswick, has invented a switch for street railways which can be operated from the car by simply pressing a button. The device obviates the necessity of stopping the car and does away with switchmen, which means a saving to railway companies. Mr. Moore has patented his device both in Canada and the United States, and will now apply for European patents.

THE BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY, of Victoria, B. C., is having installed a complete plant for developing the water power at Goldstream, for operating the street railway and the electric light plant. The work is being done under contract by Hasson & Hunt, mechanical engineers, San Francisco, Cal., and the plant is expected to be in operation by midsummer. The power house will be stationed at Goldstream, about 12 miles from Victoria. The contracts for the electrical and hydraulic machinery have been closed, and the construction is being pushed with rapidity. The electrical apparatus will be of the Canadian General three-phase type, using rotary converters and transformers to distribute over the line as the two-phase, with a voltage capacity of 11,000. Two Pelton water wheels will be used, with a capacity of 600 horse-power each, delivering 1000 horse-power in Victoria. Provision is also being made for 600 additional horse-power if required. The power delivered in Victoria will be sufficient to operate the street railway, electric lighting system, commercial and municipal, and also to furnish considerable power for the operation of stationary motors for manufacturing purposes, elevators, etc.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, April 21, 1898.

MEETING OF LA SOCIETE DES ELECTRICIENS.—The regular meeting of the society was held on May 4, with M. Picou, who was appointed president at the last meeting, presiding, assisted by M. Monnier, vice-president. The new president thanked the members for the honor conferred upon him, and spoke in commendation of his predecessor, Dr. d'Arsonval, and in closing promised to serve the society to the best of his ability. M. Laporte, the chief experimenter at the central laboratory of electricity, presented a paper on the results of his studies on the ordinary photometric standards. He discussed the Carcel and the Hefner lamps and the paraffin candle. He then gave the results of the measurements of the luminous intensity of various lamps which had been standardized by the Electro-Technical Institute of Berlin, with the following figures: One taking 0.388 amperes at 108.5 volts showed an intensity of ten Hefners, and one taking 0.0489 amperes at 111.5 volts showed sixteen Hefners. The tests at the central laboratory showed the first lamp to give 8.7 candle-power and the second 14.2. The author had also measured the luminous intensity of one and the same incandescent lamp in different standards. He found this to be respectively, 0.341 Carcel, 0.72 Hefners and 3.13 candle-power. M. P. Girault also presented a communication on the subject of "Commutation in Continuous Current Dynamos," containing a large number of mathematical formulæ.

ELECTRIC LIGHTING AND ELECTRIC WATER TRAFFIC IN GHENT.—One of the features of the Flemish capital is the large number of canals and waterways which thread it from end to end. It has at last been noticed that this watery network is very well adapted to passenger traffic. The numerous drawbridges which interfere with the travel of the street cars make any regularity of service very difficult of attainment, if not absolutely impossible. A company is to be formed to establish a passenger service by a system of electric boats. It seems very strange that this idea was not long since put

into practice, as such a system would be quite as valuable as the electric cars are in ordinary cities, and the enterprise should pay even better, since there are no steel tracks to swell the expense and maintenance accounts. It is expected that electric towing done by electric locomotives on the banks will shortly be installed on the canals from Ghent to Terneusen and from Ghent to Bruges. The city of Ghent is also increasing its warehouses and has contracted for a 25-kw generator and a battery of accumulators. In point of fact the ship-brokers, for their night work, pay 60 centimes (12 cents) an hour for an arc lamp. With each of these lamps they have the use of four incandescent lamps with flexible cord, which they attach to the arc lamps; they are enabled in this way to light up the holds of boats while loading and unloading. The intention is to extend this system to the other side of the warehouse. The authorities of the city of Ghent are contemplating the installation of a central station in the outer port for supplying the energy for lighting and operating the derricks and other machinery of the port. The new theatre which the city is building will also be furnished with a considerable electric light plant.

SOUTH AFRICAN NOTES.

JOHANNESBURG, April 16, 1898.

RAND CENTRAL ELECTRIC WORKS.—Some of the mining companies which have entered into arrangements with the owners of this plant (which is one of the two 10,000-volt transmission plants at present working in South Africa) have found the interruptions to the service to have assumed proportions so serious that it is reported they talk of cancelling their contracts. It would appear that the electric company has some difficulty in fixing upon the cause of its troubles, though the outside electricians of Johannesburg seem to be fairly unanimous in putting it down to the use of iron for insulator pins, cross arms and poles. It would be interesting to know whether a similar combination, resulting as it does in earthing all insulator pins, has ever been tried in America, and if so, with what results.

AFRICAN THUNDERSTORMS.—Owing probably to the great altitude of a great part of South Africa above the sea and its nearness to the tropics thunderstorms are both frequent and severe. The managers of several plants within the writer's knowledge, after having tried very sort of arrester of which they could get hold, have ultimately concluded it to be the safest thing to shut their plants down whenever a storm approaches within 5 or 6 miles. Considering that most of the plants hereabout are run in the interests of mining ventures, which of course means that twenty-four hours run per day is expected, and that these stoppages for thunderstorms sometimes amount to as much as twelve hours at one time, it will be evident that there is a very real need for an efficient lightning arrester. A considerable amount of interest was therefore evinced in Mr. McBlain's paper on "Lightning and Lightning Arresters," which recently occupied two sittings of the South African Society of Electrical Engineers at Johannesburg. Mr. McBlain commenced by referring to the theory of lightning discharges, and then proceeded to review some of the arresters, dividing them into two classes, acording as they had a permanent or temporary earth. Of the former class he quotes only one example—J. H. Davies' "tank" arrester—of which he seems not to have a very high opinion. He does not appear to have had any experience of Wurts' charred wood arrangement, which is another that is giving a permanent though high resistance earth. Of the temporary earth arresters he disapproves of Lodge's on account of the fuses in series with the air gaps, and considers Blackmore's an improvement in that a resistance is substituted for the fuse. He objects to the mechanical movement in the Brush and Siemens & Halske apparatus. The Thomson-Houston magnetic break he considers good in principle, but defective in detail, in which respect he thinks Crother's an improvement. This last he says has not been known to fail, but he does not show that it has been at all extensively used. He does not think the Wurts' "non-arcing" metal arrester is any good, nor does he believe in that inventor's node and loop theory of the action of lightning. On the other hand Wurts' arresters appear to have given remarkable satisfaction at the large generating station recently put up at the Rand-Victoria mine by the General Electric Power Company. One of the most important points in connection with putting up lightning arresters, namely, that no possible form of such apparatus, nor even for that matter a dead earth placed at each end of a long line, can be expected to protect intermediate points from damage, does not seem to have been brought out at all at the meetings. The discussion that followed the reading of the paper did not throw much additional light on the subject.

General News.

NEW INCORPORATIONS.

THE LEAKE TELEPHONE COMPANY, Racine, Wis., has been incorporated.

THE VICTOR ELECTRIC COMPANY, Alexandria, Va., has been formed with a capital stock of $25,000.

THE MARTIN TELEPHONE COMPANY, Johnson City, Tex., has been incorporated with a capital stock of $10,000.

THE ALBION FARMERS TELEPHONE COMPANY, Florenceville, Ia., has been incorporated with a capital stock of $400.

THE COXSACKIE ELECTRIC LIGHT COMPANY, Catskill, N. Y., has been formed with a capital stock of $20,000, and the charter runs for fifty years.

THE SUFFOLK GAS & ELECTRIC LIGHT COMPANY, Babylon, N. Y., has been formed with a capital stock of $200,000. The directors are Charles F. Street, Hunter Wykes and W. B. Hord.

THE UNITED STATES CARBON COMPANY, Cleveland, Ohio, has been organized with a capital stock of $100,000. The incorporators are H. D. Smith, H. H. Young, Braxton Davenport and others.

THE NICOLLET COUNTY TELEPHONE & TELEGRAPH COMPANY has been incorporated at St. Paul, Minn., for the purpose of building a line from St. Peter to Sibley, with its business office in New Sweden. The incorporators are C. C. Nelson, Joseph Peterson, A. L. Strauch, J. H. Housman, Martin P. Quist, Joseph A. Poetz, C. O. Gustafson, Henry A. Burke and August Olson. The capital stock of the company is $3000.

THE DES MOINES SOUTHWESTERN TELEPHONE COMPANY, Clearfield, Ia., has been formed with a capital stock of $20,000. The incorporators are D. N. Smith, R. R. Smith, C. F. Baum and S. L. Baum.

THE KUSHEQUA RAILROAD COMPANY, Kushequa, Pa., has been incorporated with a capital stock of $15,000 to build an electric railroad 15 miles long in McKean County. The directors are Elisha K. Kane, A. B. Cody, T. E. Moulton and others of Kushequa.

THE NORTHEASTERN TELEPHONE COMPANY, Rush City, Minn., has filed articles of incorporation with the Secretary of State. The principal incorporators are A. J. Stowe, C. F. Jackson, J. D. Markham, Rush City, and S. A. Nebel, of Danewood. The capital stock is $50,000.

THE KEY WEST ELECTRIC COMPANY has been incorporated at Elizabeth, N. J., with a capital stock of $300,000. The company will carry on a general electric business at Key West, Fla. The incorporators are Harry E. Knight, Westfield, N. J., and David J. Newland and William E. Knight, New York City.

THE OHIO TELEPHONE TOLL LINE COMPANY, Wauseon, Ohio, has been incorporated with a capital stock of $30,000. Among the incorporators are James S. Bailey, Jr., Edward L. Barber, James C. King, H. A. Barber and F. A. Lynn. The purpose of the company is to operate a telephone toll line between Toledo and Cleveland, with branches extending into adjacent counties.

THE TELEGRAPH AND TELEPHONE.

MILFORD, PA.—The Hudson River Telephone Company has been granted a franchise by the borough officials of this town.

KINDERHOOK, MICH.—The people of this place are agitating the matter of securing telephone communication with Coldwater.

OWOSSO, MICH.—The local office of the independent telephone company has been connected with the lines running from Kalamazoo to Lansing.

BRENHAM, TEX.—A company has been organized here to build a telephone line between Brenham and Shelby, Austin County, by way of Greenville and Saturn.

WARREN, OHIO.—Workmen are engaged in stringing the wires for the new line of the Warren-Niles Telephone Company. The company has 275 subscribers in Warren.

CAMBRIDGE, MINN.—The Northwestern Telephone Company will extend its line from St. Francis to Cambridge. It is expected that the work will be completed by June 15.

BOSTON, MASS.—During the month of April the Erie Telegraph & Telephone Company added 494 subscribers to its system. The total number connected May 1 was 26,186.

ELMA, IA.—The Northwestern Telephone Company has commenced the building of a line between Elma and Charles City, and it is probable that the line will be continued to Cresco.

KENNETT SQUARE, PA.—The Chester County Telegraph & Telephone Company is arranging to extend its line from West Chester to Oxford via Kennett Square, Avondale and West Grove.

PROPHETSTOWN, ILL.—A movement is on foot to organize a company to build a telephone line between this place and Hooppole. Mr. Amos Ott, of this place, is interested, together with merchants and citizens of Hooppole.

ATLANTIC, IA.—The Atlantic, Mt. Etna & Corning Telephone Company has completed its line to Atlantic, thus giving communication south with Cumberland, Massena and other places. The lines will be extended to other cities.

MICHIGAMME, MICH.—The Marquette County Telephone Company's lines are being extended from Ishpeming to this place, and will include the towns of Republic, Champion and Humboldt. The new tributary has a population of about 10,000.

BURLINGTON, VT.—The New England Telephone & Telegraph Company is extending its line from Swanton to Rouse's Point, N. Y., thereby making a short route from this city to Plattsburg. The new line is about 16 miles in length, and crosses the lake upon the Rouse's Point bridge.

RICHMOND, IND.—Steps are being taken in this city looking to the organization of an independent telephone company. It is an outgrowth of the Cambridge City Telephone Company, which is extending its lines throughout this portion of the State.

TORRINGTON, CONN.—A special telephone exchange has been established at the State military rendezvous at Niantic by the Southern New England Telephone Company. This exchange is for the benefit of the soldiers encamped, and will be maintained as long as the military is stationed at that point.

PITTSBURG, PA.—A meeting of the stockholders of the Maryland, Pennsylvania & West Virginia Telephone & Telegraph Company, to be held in this city, is called for May 21. It is proposed to take action on the question of increasing the capital stock of the company to $5,000,000.

NEW YORK, N. Y.—At the annual meeting of the New England Telegraph & Telephone Company, which was held in this city recently, directors were re-elected with the exception of Mr. William H. Forbes and Mr. Morgan, deceased, who were replaced by Thomas B. Bailey and Winfield S. Hutchinson.

TIFFIN, OHIO.—The Home Telephone Company, of this city, will soon commence work in the building of toll lines from Tiffin to Fort Seneca, Green Spring, Berwick, Adrian and other places. The company's line to Fostoria is about completed. The company now has about 450 telephones connected with its Tiffin exchange.

PARIS, ILL.—Representatives of independent telephone companies recently met in this city for the purpose of forming an association to promote social relations between the parties interested; to establish a uniform rate of tolls and "paralyze monopolistic competition." A permanent association was effected. Among those present were P. G. Farrow, Paris, Ill.; Dr. I. A. Lumpkin, Mattoon, Ill.; F. C. Brooks, Charleston, Ill.; O. K. Burton, Isabel, Ill., and J. H. Horney, of Clinton.

BOSTON, MASS.—The report of the Mexican Telephone Company, covering operations for the year ending February 28, 1898, which was issued a few days ago, shows the following results: Telephones in service, 2486, increase 140; rentals, $121,513, increase $297; gross earnings (Mexican currency), $128,364, increase $5618; gross expenses (Mexican currency), $80,792, decrease $4747; net earnings, $47,571, increase $10,364. (The average value of the Mexican dollar as given in the report is 46.37 cents.) The indebtedness of the company to the International & Mortgage Bank of Mexico, amounting to $7707, has been paid in full, and the company now has no debts excepting current accounts. The property, according to the report of President Browne, was never in better condition than it is at present. Metallic circuits have been introduced in the city of Mexico, the cost of which has been paid out of the earnings. Business is on the increase in the large exchanges, such as Mexico, Monterey, San Luis Potosi and Guadalajara.

SCRANTON, PA.—An ordinance is now before the City Council granting a franchise to the Lackawanna Telephone Company to operate a system in this city. In consideration of the rights and privileges so granted the company will be required to put in operation within one year from the date of approval of the ordinance a system sufficiently large to supply at least 500 subscribers. The Lackawanna Telephone Company, which is an independent concern, proposes to build an exchange in Scranton. The latest improved long-distance telephones will be installed, and copper wire metallic circuits will be built. The prices charged by the company will be $2 for residence 'phones and $3 for business instruments per month. Arrangements are being made whereby the Lackawanna Company expects to furnish its subscribers with through service between Scranton and Wilkesbarre. It will also make connections with all the towns up and down the valley between Carbondale and Wilkesbarre. The company has now in the neighborhood of 1000 subscribers, and it hopes to have its exchange in operation not later than September 1 next. The officers of the Lackawanna Telephone Company are Conrad Schroeder, president; William L. Connell, vice-president; George S. Horn, secretary and treasurer.

Electric Light and Power.

ROCHESTER, N. Y.—The town of Charlotte has voted in favor of bonding in the sum of $35,000 to establish a system of electric lights.

LYNN, MASS.—In the Massachusetts House the bill to regulate the payment of dividends by gas and electric light companies was rejected on the first call of the calendar.

LAWSON, MO.—A petition has been presented to the Aldermen asking them to submit to a vote of the people a proposition to bond the city for $2000 to put in an electric light system.

RICHMOND, VA.—Preparations are making to extend the street conduit system at once so that the wires can be laid before the streets are asphalted in order that the latter need not again be torn up.

DETROIT, MICH.—Cass City's special election, to vote on the proposition to bond the village for $18,000 for waterworks and electric lights has had to be postponed on account of some irregularity in the preliminaries.

BINGHAMTON, N. Y.—The Binghamton Gas & Electric Company has, it is stated, been sold for $360,000. The purchasers are Messrs. Emerson, McMillan & Co., New York, who will expend $50,000 on betterments this summer.

ELKHORN, WIS.—The city of Elkhorn at the recent election voted $10,000 in bonds for the electric light plant. Mr. John S. Allen is superintendent of construction and general manager of the electric light plant and water works.

DETROIT, MICH.—By a contract filed in the City Clerk's office the Siemens & Halske Electric Company of America agrees to furnish the Detroit, Lake Shore & Mt. Clemens Railway, within sixty days, two generators and a switchboard for $14,500.

PHILADELPHIA, PA.—The Lansdale Electric Light Company has sold to the borough of Lansdale the entire electric light plant for $4000. The borough will now purchase a lot and erect a building. The voters gave their consent to the scheme at the last election.

CHICAGO, ILL.—The Cicero Electric Light & Power Company's plant was burned on May 7. The plant was at Lombard Avenue and Harrison Street. Its destruction brings darkness to Austin, Hawthorne, Morton Park, Clyde, Lavergne and Berwyn. The loss is over $50,000.

CHICAGO, ILL.—There is talk of making a campaign issue this fall on municipal ownership of gas and electric light plants. An effort will be made to exact pledges from candidates to favor the project. A revision of the city charter by the Legislature would be necessary, and the people would have to vote on the question.

CHICAGO, ILL.—It is reported that Edison interests are now in absolute control of the entire electric lighting business of Chicago. They have within a few months purchased the stock of every independent electric light company. All these companies, some thirty in number, are not to be merged with the Chicago Edison Company, but will be consolidated into one company under the name of the Commonwealth Electric Company.

NEW YORK CITY.—American manufacturers will have an opportunity to bid for many requirements needed at Toronto, Canada. The City Council has adopted a report from the board of control recommending that the city engineer be instructed to have specifications prepared for a 2000-hp plant for lighting the streets and the new city buildings; also that bids be invited for the construction of such plant. The report as adopted recommends that bids be invited for a 6000-hp plant for street and electric lighting, bidders to be allowed to bid on their own specifications. The matter is in charge of Mayor Shaw and Aldermen Leslie, Hubbard and Burns. Mr. C. H. Ruse is city engineer.

The Electric Railway.

VALATIE, N. Y.—The Coxsackie trolley road will be finished by October. It will run from Coxsackie to Urlton, to Greenville and thence to Middleburg.

NEW YORK CITY.—Arrangements are about completed for the incorporation of the Rochester & Sodus Bay Railroad Company, which is to build an electric line from Rochester to Sodus Bay, 30 miles. The promoters are Joseph C. Tone, Ira M. Ludington and Charles Van Voorhis. Freight also will be carried.

SOUTH BETHLEHEM, PA.—Two rival trolley companies are trying to secure permission from the borough of Coplay for a line in that town to connect with Egypt.

NEW YORK CITY.—An order has come to a prominent American firm for three 300-hp steam engines, for the new electric railway to be constructed in Sheffield, England.

MIDDLETOWN, CONN.—The Middletown Street Railway Company has made a five-year contract with the Middletown Electric Light Company for power for the street cars.

HARTFORD, CONN.—Now that the extension of the trolley from Middletown to Crystal Lake Park is a certainty the managers of the latter are spending a great deal of money in improvements.

NEW YORK CITY.—The Westchester Electric Railroad Company has filed in the County Clerk's office notice of its intention to extend its roads and construct branches in the various thoroughfares in the city of Mount Vernon.

DETROIT, MICH.—The Detroit Electric Railway Company has recently made a proposition to reduce the wages of motormen and conductors from 21 to 18 cents an hour. The company has found the 3-cent fare insufficient to pay expenses.

ROCHESTER, N. Y.—Another effort is being made in Canandaigua to construct an electric line to Manchester to connect with the Lehigh Valley. It is said Buffalo capitalists are ready to build the road if the citizens will subscribe $20,000.

PLAINFIELD, N. J.—In the construction of the trolley from Dunellen to Bound Brook it will be necessary to erect at least two bridges and possibly three, and complications are likely to arise between the Brunswick Traction Company and the Board of Freeholders.

WASHINGTON, D. C.—The House Committee on the District of Columbia has reported favorably the bill to incorporate the East Washington Traction Company. The overhead trolley is to be used. The incorporators include Archibald M. Bliss, George S. Boutwell and several citizens of New York and Brooklyn.

PITTSBURG, PA.—Trolley aggressiveness is on the increase. The electric roads are preparing hereabout to fight the steam roads this summer for the picnic resort traffic. Much money has already been expended in fitting up by parks owned or rented by trolley companies.

MIDDLETOWN, CONN.—The officials of the Middletown street railway have just announced that the proposed extension of the trolley line to Crystal Lake Park has been abandoned for this year at least, and very likely for good. It was found impossible to make satisfactory arrangements with the owners of the park.

BROOKLYN, N. Y.—The Brooklyn Heights Railroad Company management has decided to build a new storage building for the Myrtle and Gates Avenue lines. The new structure will be the largest in the city, and will have accommodations for 612 cars. It will be situated on the site of the present Ridgewood station, and will cost $150,000.

PHILADELPHIA, PA.—A preliminary meeting of capitalists has been held at Atlantic City, N. J., to organize an electric railroad company to build a line across the State of New Jersey from Camden to Atlantic City. The capital stock is $600,000. J. J. Patterson, of Philadelphia, was chosen president, and A. A. Welhouse, of Lancaster, Pa., secretary.

NEW HAVEN, CONN.—The cars upon the third-rail route between New Britain and Hartford are to stop hereafter at two intermediate stations and be slightly accelerated in speed. The fare is to be 10 cents between all stations. The extension of 9 miles to Bristol is almost completed. The building of the Plainville & Farmington trolley road, contracts for which have been let, will make possible a continuous cross-country trolley trip of about 30 miles in the region west of Hartford.

NEW HAVEN, CONN.—Ground has been broken for the Groton & New London extension of the Norwich & Worcester Railroad, and the new line will probably be operated late in the summer. There have been several surveys of the route, but the one finally adopted follows pretty closely the windings of the river, one motive, it is said, being the adaptation of the line to views of boat races on the Thames. The work of improving the present road between Norwich and Allyn's Point, and adapting it to heavier traffic, has gone on rapidly, and the extension is to match the old road in perfection of road bed and heavy weight of rails.

Legal Note.

CONDENSER ELECTROMAGNETS.—During the past three years an important interference contest has been pending in the United States Patent Office between one of the patents of the American Bell Telephone Company and an application for patent of Mr. John T. Williams, the inventor of the Portelectric carrier system, the subject of which is condenser electromagnets, or electromagnets embodying in the same structure, an electrical condenser. In this device the winding of the magnet forms one electrode or plate of the condenser, while another interwound conductor forms the other electrode, the insulating material of the wires serving as a dielectric. The purpose of this invention is to suppress the evil effects of self-induction in the magnet winding.

and so quicken or sharpen the response of the armature, and is especially effective on alternating or rapidly interrupted current circuits. The case was recently finally decided in favor of Mr. Williams. Mr. William A. Rosenbaum, of New York, appeared for Williams, while Mr. W. W. Swan, of Boston, and Messrs. Pollok & Mauro, of Washington, D. C., represented the Bell Company.

PERSONAL NOTES.

MR. HUGO DIEMER, formerly of Diemer & Hebble, Cincinnati, has accepted a position with the Westinghouse Electric & Manufacturing Company at Atlanta, Ga.

MR. CHARLES J. GLIDDEN has been appointed president of the Erie Telephone & Telegraph Company. Mr. Glidden's headquarters are in Lowell, Mass. He was formerly vice-president of the same company.

MR. JOHN RICE, salesman of the National Carbon Company, of Cleveland, Ohio, and who is so well and favorably known to the carbon consuming trade, severed his connection with that company on May 15, and has accepted a similar position with the Phœnix Carbon Manufacturing Company, St. Louis, Mo.

MR. S. J. WICK, of the Electric Railway Equipment Company, Cincinnati, Ohio, was in New York last week and a visitor to the Electrical Exhibition. The Electric Railway Equipment Company is now manufacturing its well-known iron poles at Reading, Pa., for the Eastern and foreign markets. Manufacturing is also continued as heretofore in Cincinnati. The business of the company is rapidly increasing. The shipments in April aggregated 125 carloads of poles. Mr. George Wick is superintendent of the factory at Reading.

MAJOR R. J. RANDOLPH, for many years Western manager in Chicago of the Excelsior Electric Company, has resigned that position to become the general sales agent of the Sterling Arc Lamp Company, 214-222 West Twenty-sixth Street, New York. This company manufactures the Schefbauer series enclosed arc lamp, which is meeting with so much success. Major Randolph is one of the best-known men connected in a commercial way with the electrical business, and his many friends will join with THE ELECTRICAL WORLD in wishing him every success in his new field of labor.

TRADE AND MISCELLANEOUS PUBLICATIONS.

THE LEE-PENBERTHY MANUFACTURING COMPANY, Detroit, Mich., manufacturer of the Lee ball valve automatic injector, has issued a manual of useful information, such as discount tables, pipe tables, railroad distances, population of cities and countries, etc., convenient for users, sellers and manufacturers of steam goods and kindred lines. The company makes a charge of 50 cents a copy for this book, which contains fifty pages, and it will no doubt be found very useful to the class of persons mentioned above.

THE WORCESTER POLYTECHNIC INSTITUTE in its twenty-eighth annual catalogue gives a great deal of information concerning the facilities and courses taught at that institution. The catalogue contains 194 pages, and includes a list of those who have been graduated from the institute up to February 1, 1898. The "Journal" of the Worcester Polytechnic Institute is published bi-monthly. The contents of the March number include an excellent article on the Boston subway, written by Robert B. Farwell, and an article by Harold B. Smith on the "Development of a School of Electrical Engineering." The journal is neatly gotten up.

THE SAFETY CONDUIT COMPANY, Rankin Station, Pa., has issued a little pamphlet giving information regarding "Loricated" electric conduits, of which it is the manufacturer. These conduits, which are unlined, are for interior construction. Some facts concerning the character and manufacture of "Loricated" conduits were published in THE ELECTRICAL WORLD of March 12. "Loricated" electric iron armored conduits have been installed in many prominent buildings, and they have been approved for use by the National Board of Fire Underwriters and local boards.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has just issued Bulletin 2 F, which relates to the Western Electric ceiling fans for direct current. Five different styles of fans are illustrated. The company has also issued a twenty-four-page pamphlet on tools, which contains a most complete list of lineman's and construction tools, all of which can be furnished from stock. Everyone interested in the construction of electric lines should have a copy, and the Western Electric Company will mail one upon request to anyone desiring it. This pamphlet is known as Tool Catalogue No. 3.

THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, has just issued a pamphlet entitled a "Record of Recent Construction." The recent construction includes a four-coupled switching electric locomotive built for the Golden Sceptre Gold Mining Company; also a four-wheel mining type electric locomotive built for the Shawmut Gold Mining Company. The switching electric locomotive is guaranteed to haul a train of mine cars weighing in all 35 tons up a maximum grade of 5 per cent. The mining locomotive is guaranteed to have a draw-bar pull of 1000 pounds at a speed of 8 miles per hour, and a starting pull of at least 40 per cent. greater than the ordinary running pull.

THE ELECTRICAL DEPARTMENT of the Erie City Iron Works, Erie, Pa., has issued a catalogue of its electrical apparatus. In it are illustrated and described slow-speed generators and motors, direct-connected engines and generators, the "A" bipolar generator, and the "B" bipolar generator. Each machine, as indicated by the illustration, seems to be well designed and makes a pleasing appearance. Tabulated dimensions of the various machines are presented for quick reference. A copy of the same catalogue is separately bound for the Mexican trade. Mr. G. M. Bushnell is the Erie City Iron Works agent in the republic of Mexico, his office being in the City of Mexico.

STURTEVANT ENGINES for electric light plants and general high-grade work constitute the subject of an illustrated catalogue just issued by the B. F. Sturtevant Company, Boston, Mass. Among the engines illustrated and described are single-valve upright engines, throttling and automatic cut-off; single upright engine direct connected to multipolar dynamos; automatic double-enclosed upright engine; compound enclosed upright engine; automatic cut-off and throttling side crank horizontal engines, etc. All of these types of engines are also shown direct connected to electric generators, and each one is accompanied by a diagram and table showing the principal dimensions of the various sizes of engines.

ELECTRICAL ENGINEERING AT THE UNIVERSITY OF WISCONSIN.—A handsomely illustrated pamphlet entitled "Picturesque University of Wisconsin" has been issued containing considerable information concerning the engineering courses. The electrical engineering course was organized in 1891, the first class of eight students being graduated in 1893, fifty-four other students having graduated from this course since that year. Of these 15 per cent. are now engaged as professors, teachers, etc., in electrical engineering; 13 per cent. are chief engineers, superintendents, contractors; 43 per cent. assistant engineers, designers and draughtsmen. The electrical laboratories consist in part of a dynamo room, an electrolysis laboratory and an alternating current laboratory. The first contains no less than twenty dynamos and motors of different types, of considerable capacity, and especially arranged for experimental work. The second contains electroplating, electrotyping and electro-refining apparatus, as well as several electric furnaces. One of these is of the Moissan type. The third contains six alternating current dynamos and motors with the instruments required for testing and experimenting with them. The construction and shop work at the university is highly developed, the success of this department being shown by the design and construction by the students of a 1,000,000-gallon pumping engine, a steam hammer, a compound marine engine and many large models and engines now in use in the laboratories. Prof. D. C. Jackson is in charge of the Electrical Engineering Course.

Trade and Industrial Notes.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY has removed its New York office to 141 Broadway, room 909.

MR. R. C. DEMARY, 133 Erie County Bank Building, Buffalo, N. Y., is distributing in the trade a card calling attention to the fact that the Demary quick-break switches are excellent in design and workmanship.

MESSRS. SIPE & SIGLER have received orders for Willard batteries from the Riker Electric Motor Company, of Brooklyn, New York, and the Fischer Equipment Company, of Chicago, for motor vehicles sold in Paris.

THE AMERICAN TELEPHONE & TELEGRAPH COMPANY is distributing war atlases, which will be found very useful at the present time in connection with the movements of the naval squadrons of the United States and Spain.

THE A. L. BOGART COMPANY, New York City, manufacturer and dealer in electric gas lighting apparatus, supplies and electrical specialties, has removed to 123 Liberty Street, in order to be nearer the centre of the electrical trade. The offices at 50 East Twentieth Street will be maintained until June 1 for the reception of orders, etc.

THE PENNSYLVANIA ELECTRIC COMPANY, Marietta, Pa., has issued a large sheet illustrating the various styles of telephone apparatus manufactured and dealt in by it. The illustrations represent complete telephone sets of various styles, transmitter arms, motor-generators, magnetos, desk sets, receivers, switch hooks, etc., etc.

THE AMERICAN RHEOSTAT COMPANY, Milwaukee, Wis., is doing a lively business. Some very heavy work is being done in the line of printing press controllers. Orders have been received from Japan, Belgium and England. There seems to be no doubt that the company's goods are becoming well known, not only in this country but in foreign countries as well.

MESSRS. ZIMDARS & HUNT, 127 Fifth Avenue, New York, have issued an attractive folder, "Bulletin C," giving prices on all sizes of their new automatic motor starter, from ½ to 25 horse-power, for all voltages. A copy of this Bulletin can be obtained on request. This automatic motor starter, which is just being placed upon the market, is described and illustrated on another page in this issue.

THE ELECTRICAL APPLIANCE COMPANY, Chicago, has recently concluded the general distribution of its fan catalogue for the season of 1898. In sending out catalogues to a very large list of buyers it is very often the case that some are overlooked. The Electric Appliance Company would be pleased to hear from anyone in the trade who has not received a copy of this handsome catalogue, as it is anxious to place the same in the hands of every possible user or purchaser of fan motors.

THE BOULDER ELECTRIC LIGHT COMPANY, Boulder, Col., which has already a number of Ball engines in satisfactory use, has recently ordered from the Ball Engine Company, Erie, Pa., a 100-hp engine, arranged for direct connection to a 60-kw General Electric generator. The Peruna Drug Manufacturing Company, Columbus, Ohio, has recently ordered from the Ball Engine Company and the Siemens & Halske Electric Company two 150-hp Ball engines direct connected to 75-kw generators, and one 225-hp engine direct connected to a 150-kw generator.

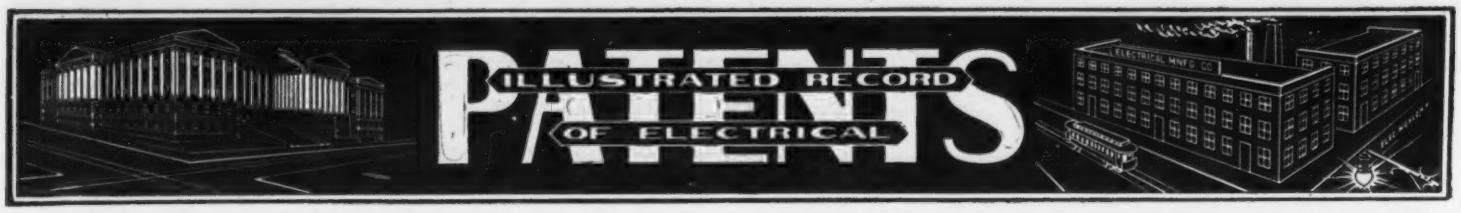
THE ELECTRICAL COURSES of the United Correspondence Schools, 154-156-158 Fifth Avenue, New York, have, it is reported, been giving remarkably satisfactory results. These courses are seven in number, as follows: Complete electrical engineering, complete station engineering, electrical station engineering, electric lighting, electric railways, telegraph and telephone, and electro-plating. All interested in electricity should write for the illustrated circular P, which contains sample pages of instruction books, prices, courses, sample drawing plate, etc.

THE NEW POWER STATION and car house being erected by the Spencer, Warren & Brookfield Street Railway Company, at Brookfield, Mass., will have steel roof trusses and covering furnished by the Berlin Iron Bridge Company, East Berlin, Conn. The dynamo and engine room roofs of this building will be lined with the Berlin Company's patent anti-condensation roof lining, which is now very extensively used for roofs of this nature throughout the country. It prevents the condensation of moisture from the under side of the roof covering, which, if it should collect and drop upon the machines beneath, would cause considerable damage.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

THE AMERICAN NAVY, CUBA AND HAWAII.—A portfolio, in ten parts, sixteen views in each part, of the finest half-tone pictures of the American Navy, Cuba and Hawaii has just been published, and the Chicago, Milwaukee & St. Paul Railway has made arrangements for a special edition for the benefit of its patrons, and will furnish the full set, 160 pictures, for $1. In view of the present excitement regarding Cuba these pictures are very timely. Send amount with full adddress to George H. Heafford, General Passenger Agent, C. M. & St. P. Ry., Chicago, Ill.

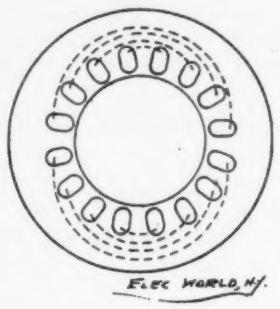


UNITED STATES PATENTS ISSUED MAY 17, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

604,033. ELECTRICAL SAFE PROTECTION SYSTEM; I. Freed, Harrisburg, Pa. App. filed June 15, 1897. A system to so protect a safe that while the rightful parties may have convenient access to same, the unauthorized tampering with the safe will immediately sound a local or distant alarm.

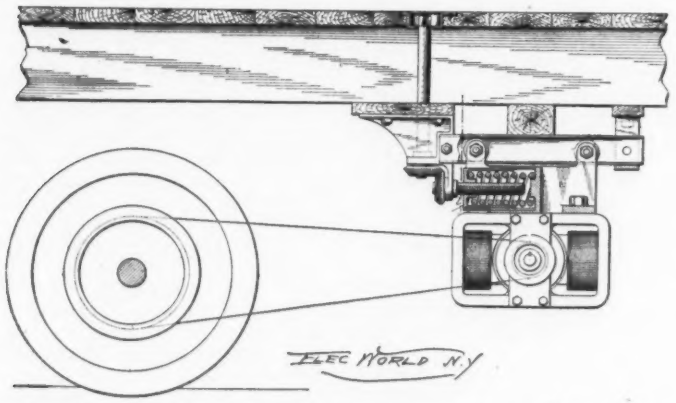
604,055. ELECTROMAGNET HAVING ROTATING FIELDS; W. Langdon-Davies, London, England. App. filed May 23, 1896. An electromagnet energized from a single source of alternating E. M. F., comprising two component fields of equal rates of alternation, but with different phase angles of magnetization, having their magnetic axes inclined one to the other at an angle other than 90 degrees and equal to the supplements of that angle by which the currents in the two component windings differ in phase, thus producing a rotary field.



604,055.—Electromagnet Having Rotating Fields.

604,081-2-3-4-5. ELECTRIC LIGHTING SYSTEM FOR RAILWAY CARS; W. F. Richards, Buffalo, N. Y. App. filed, respectively, Sept. 16, 22, 25, Oct. 11, 14, 1897. These inventions relate to electric lighting apparatus for railroad cars, in which the dynamo is driven from the car axle by a belt and the dynamo is movable toward and from the driving axle, so that the belt slips when the speed of the driving axle exceeds that which is necessary to properly drive the dynamo, thereby neutralizing such excess of speed and maintaining a practically uniform normal speed of the dynamo.

604,094. TELEPHONE SWITCHBOARD PLUG; J. Taylor, Heathercliffe Helsby, England. App. filed Nov. 21, 1896. This invention comprises improvements in the construction of triple contact telephone plugs, rendering it possible for a plug to be readily taken to pieces for repairs and readjustments and to be fitted together again with facility.



604,084.—Electric Lighting Apparatus for Railway Cars.

604,098. RAIL CONDUCTOR FOR ELECTRIC SYSTEMS; L. E. Walkins, Springfield, Mass. App. filed Aug. 18, 1897. This invention relates to improved rail conductors for electric railway systems and other electric systems, wherein a circuit is closed through that portion of the rail upon which the car may be running by a portion of or an attachment to the car.

604,101. ELECTRIC LIGHTING APPARATUS FOR CARS; E. Wilhelm and Willard F. Richards, Buffalo, N. Y. App. filed Oct. 23, 1897. A support on which the dynamo (described in patent 604,081, etc.) can move toward and from the car axle, and whereby the weight of the dynamo is rendered effective for causing such variations in the tension and friction of the belt as are necessary to maintain a practically uniform speed of the dynamo.

604,137. APPARATUS FOR ELECTRICALLY WORKING METALS; J. D. Bishop, New York, N. Y. App. filed May 6, 1897. Means for making electric conductors or metal wire, consisting of a refractory chamber containing a die, means for feeding bars of metal therein and forcing them into contact with one another at or near the die, by pressure applied behind the die, and connections for leading an electric current through the bars.

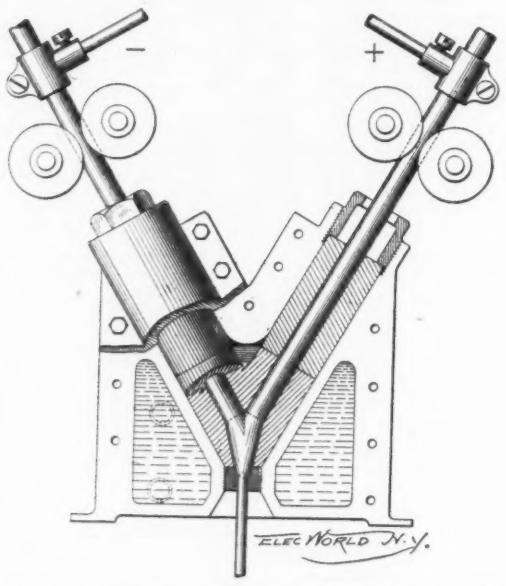
604,157. CIRCUIT CLOSER; W. D. Kennedy, Easton, Pa. App. filed March 25, 1895. In a circuit closer, the combination with a hollow base, of oppositely curved thermostatic plates located respectively in the opposite sides of the base, and forming terminals of an electric circuit, one being formed to act below and the other above the normal temperature, adjustable terminals adjacent to the plates, and a manual closer on the base.

604,169. TROLLEY FOR ELECTRIC RAIYWAYS; S. H. Short, Cleveland, Ohio. App. filed Sept. 26, 1898. This invention relates to improvements in electric railways, having an overhead conductor, a motor car and an underrunning trolley device, carried by the car.

604,219. ELECTRIC ARC LAMP; F. W. Steinacker and E. F. Cowley, Cleveland, Ohio. App. filed April 12, 1897. In an electric arc lamp, a telescoping holder, composed of an outer stationary tube and an inner movable tube in contact therewith, said inner tube being adapted to hold the movable carbon, and being adapted to slide up and down within the stationary tube, and while the lamp is burning, being adapted to have its upper portion in the lower portion of the outer tube, said outer tube thereby acting as an extension of the inner tube.

604,220. COMMUTATOR BRUSH HOLDER; W. B. Stull, Bayonne, N. J. App. filed Feb. 12, 1898. A commutator brush holder, comprising the follower connected with the brush and lazy-tong levers at one end connected with the follower and at the other end to the holder, combined with means for exerting spring pressure laterally against the sides of said levers.

604,258. APPARATUS FOR JOINING TELEGRAPH CABLES; H. Menier, Paris, France. App. filed Dec. 28, 1897. An apparatus for completing telegraphic cable joints, comprising an elastic cylinder to inclose the cable joint, hollow chambers about the cylinder and means for admitting fluid pressure to the chambers to compress the cable joint.



604,137.—Apparatus for Electrically Working Metals.

604,340. COMBINED ANNUNCIATOR AND SPRING JACK; G. W. Sutton, New Rochelle, N. Y. App. filed April 8, 1897. This invention relates to combined annunciator and spring-jack structures, and has for its object to produce a compact efficiently operating organism which will be operable to perform switching operations, and in which the annunciator drop will be replaced by the action of switching the line.